VIRACON

laminated glass specs & tech

putting two and two together makes one great combo

It all starts with taking your "what if" questions and turning them into "why not" answers. Chances are, we've recommended a solution for a similar job over the past 35 years. And chances are today, we can give you a point of view other fabricators just don't feel comfortable talking about. Trust, confidence, peace of mind—it's what laminated glass experience, a broad selection of glazing options and the technical expertise to fabricate customized solutions can do for you. You'll also find a wide selection of laminated glass using tinted glass, high-performance coatings, silkscreened patterns and pigmented interlayers to provide an array of design solutions as well as the solar control options you're looking for. After all, the last thing we want is for you to have to make design changes that compromise your vision. And your clients'. It's simple: when it comes to working with you on laminated glass ideas, we're really bright. Challenge us, you'll see.

From imaginative aesthetics to strict environmental and energy issues to critical budget requirements, we know how to help you figure out a way to make it all work. That's what being a leader is all about. Architects, designers, contractors and visionaries throughout the world have come to rely on our proven experience to make Viracon their "go to" company when it comes to exploring options. And getting answers. The fact is, after 35-plus years, 100,000 buildings and 500,000,000 square feet of glazing installed in some of the world's most remarkable buildings, you learn a thing or two about what's the best thing to do. Today, we perform more glass fabricating processes at a single site than any other fabricator. Sit down, tell us your thoughts, challenge us. The sky's the limit.

Highwoods Intermedia Center

Tampa, FL

Architect: Alfonso Architects, Inc.

Glazing Contractor: Harmon, Inc.

Photographer: Wes Thompson

viraconsulting™

FIELD SALES REPRESENTATIVES

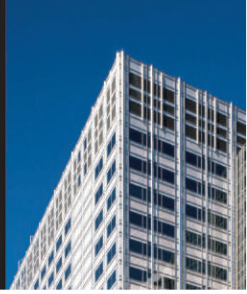
We're here to help with design assistance, budget costing, return on investment costing, spec writing and review as well as act as a liaison between architects and glazing contractors. We also work closely with the glazing contractor to offer assistance with initial costs, final pricing negotiations, product information and job site inspections. Just ask.

ACCOUNT REPRESENTATIVES & CUSTOMER SUPPORT

Call on us to help with quoting, product performance data, pricing, project coordination, samples and mockups. All it takes is a phone call.

techelp

Need an answer—fast? Our Architectural Technical Services group, along with our Architectural Design group, can assist you with specification and design assistance, performance and environmental analyses, structural calculations, energy payback, hurricane requirements and security threat levels. No problem.



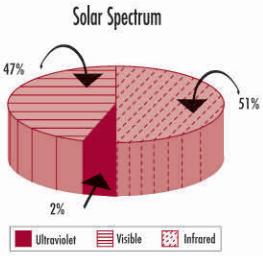


Figure 1

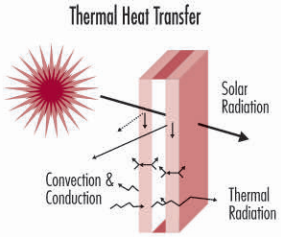


Figure 2

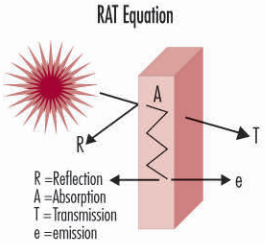


Figure 3

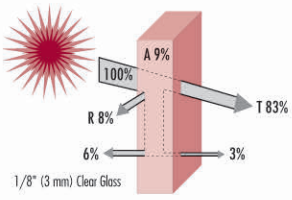


Figure 4

TERMS AND DEFINITIONS

Solar Spectrum

The solar spectrum, commonly referred to as sunlight, consists of ultraviolet light (UV), visible light and infrared light (IR). The energy distribution within the solar spectrum is approximately 2 percent UV light, 47 percent visible light and 51 percent IR light (see Figure 1). One aspect of the solar spectrum is its wavelength in which nanometer (nm) is the unit of length [1 nm = 10^{-9} m].

UV light is invisible to the human eye and has a wavelength range of ~300 - 380 nm. The damaging effects of long-term UV light exposure results in fabric fading and plastic deterioration.

Visible light is the only portion of the solar spectrum visible to the human eye. It has a wavelength band of ~380 - 780 nm. IR light is invisible to the human eye, has a wavelength range of ~790 - 3000 nm and has a penetrating heat effect. Short-wave IR light converts to heat when it is absorbed by an object.

Heat Transfer Methods

Heat transfers from one place to another via convection, conduction or radiation. Convection occurs from the upward movement of warm, light air currents. Conduction occurs when energy passes from one object to another. Radiation occurs when heat is sent through space and is capable of traveling to a distant object where it can be reflected, absorbed or transmitted (see Figure 2).

Solar Energy

When solar energy meets glass, portions of it are reflected, absorbed or transmitted—giving you the RAT equation (see Figure 3).

RAT Equation

The RAT equation accounts for 100 percent of solar energy, which is equal to the sum of solar reflectance, absorption and transmittance. For example, with a single pane of 1/8" (3 mm) clear glass, 83 percent of solar energy is transmitted, 8 percent is reflected and 9 percent is absorbed by the glass. Of the solar energy absorbed, portions are emitted back towards the exterior and towards the building interior (see Figure 4).

Solar Control

The visible light and IR portions of solar energy are an essential part of sunlight, since they represent nearly 100 percent of the solar spectrum. As a result, each plays an important role when glass is selected as a glazing material for commercial building applications. To enhance thermal performance, thin metallic films are applied to one or more glass surfaces.

Solar Reflective Coatings

Solar reflective coatings reduce solar heat gain through higher reflection and absorption with the glass appearing mirror like. Typically, the coating reflects and absorbs high amounts of visible and IR portions of the solar spectrum. As a result, heat gain is dramatically reduced, but the trade off is lower light transmission through the glass.

Structural Glazing and Butt Glazing

Laminated glass has been used successfully in both structural and butt-glazing applications. In structural glazing, the glass is bonded to interior support members with structural silicone (see Figure 5). A silicone weather seal is used to prevent water infiltration into the glazing system. Under these conditions, the glass has full edge support.

In butt-glazing applications, there is no interior glass edge support. A silicone weather seal is applied between adjacent glass plies to prevent water and air infiltration (see Figure 6). Under these conditions, one or more glass edges are unsupported, resulting in more glass deflection. Due to the higher degree of deflection, heat-treated glass plies must be used in the laminated glass construction.

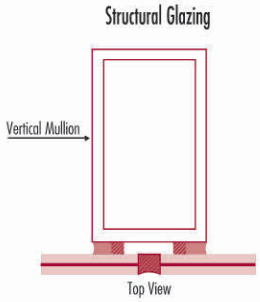


Figure 5

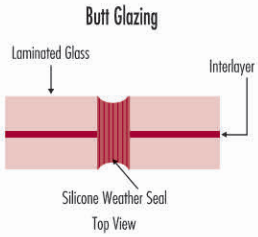


Figure 6

In either application, silicone sealants may come in contact with the polyvinyl butyral (pvb) interlayer. When silicone contacts the laminated glass edge, a cosmetic blushing of the pvb interlayer occurs over time. This blushing is a reaction between the silicone sealant and the pvb interlayer.

It generally begins as a small bubble formation at the contacted edge, which then grows to form a limited unbonded area at the glass edge. This reaction is limited and generally does not exceed more than 3/8" (9.5 mm) to 1/2" (12.7 mm). It does not affect the structural integrity of the laminated glass with respect to its ability to resist uniform loads.

Even though this cosmetic blushing is limited, it is generally not visible to the interior of the building in structural glazing applications. Also, when reflective glass is used as the outboard glass ply of the laminate, it may not be visible from the exterior.

If clear or tinted glass is used in structural glazing, or in the case of butt glazing where both edges are exposed, this blushing will be visible. This should be considered when selecting the appropriate glass type for a specific type of application.

The extent and degree to which this blushing occurs is a function of the type of generic silicone used. Acetoxy type silicones generally react more quickly than neutral cure type silicones, but with the same results.

In over 20 years of field experience, laminated glass products used in these two types of glazing systems have performed well with no harmful effects to the glass or glazing system.

Laminated Glass

Laminated architectural glass consists of a strong, pvb interlayer bonded between two glass plies, using heat and pressure. The glass plies may be of equal or unequal thickness. Laminated glass is a durable, high-performance glazing product, which ensures that the glass remains integral in the glass opening after installation.

VIRACON'S GLASS

Viracon's Laminated Glass

Viracon's laminated glass is available in various forms for commercial glazing applications. To provide a wide array of design options, as well as meet various performance levels, Viracon's laminated glass can feature tinted glass, high-performance coatings, silkscreened patterns and pigmented interlayers together or alone.

Viracon offers its pvb interlayers in three standard thicknesses: .015" (.38 mm), .030" (.76 mm) and .060" (1.5 mm). If a stronger, more durable laminated unit is required, heat-strengthening the glass is recommended. For insulating glass units, it is recommended to heat strengthen the outboard glass ply.

Viracon's Solarscreen™ High-Performance Reflective Laminated Glass

This type of glass combines the advantages of laminated glass with the superior solar control characteristics of Solarscreen reflective coatings.

Viracon's Solarscreen VH

Viracon's Solarscreen VH laminated glass products provide higher visible light transmission without sacrificing unwanted heat gain into the building. They are ideal for curtainwall and skylight applications where solar heat gain is a concern.

These products reduce heat gain and provide low shading coefficients without substantially increasing interior or exterior reflectance in comparison to uncoated glass.

VH laminated products are always constructed with a clear outboard glass ply and a coating applied to the number two surface. If tinted glass is incorporated into the laminate design, the tinted glass is installed to the interior of the building (see Figure 7).

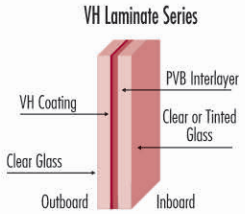


Figure 7

APPLICATIONS

Safety Application

Safety glazing applications, such as doors and sloped overheads, require a minimum .030" (.76 mm) thick pvb interlayer. Certain pvb colors, such as the Solutia color interlayer system, are available in only .015" (.38 mm) thicknesses. Consequently, clear pvb plies can be added to achieve the minimum .030" (.76 mm) thickness required in safety glazing areas.

Solar Control Application

Laminated glass also possesses other unique properties, which make it an excellent product for commercial buildings. For instance, laminated glass provides the greatest reduction of ultraviolet (UV) light transmission of any commercial glass product available.

When combined with two layers of float glass, less than one percent of UV light is transmitted. This is important when considering the type of glass product to use in applications where UV protection is essential.

However, light and heat can also contribute to the fading of interior furnishings. It is important to consider using laminated glass products, which help to reduce visible light transmission and radiant heat.

Sound Control Application

Another important element of laminated glass is acoustical performance in commercial applications. Laminated glass reduces noise transmission due to sound damping characteristics of the pvb interlayer.

While glass is inherently a poor acoustical performer, higher performance levels can be achieved by using laminated glass alone or combined with additional glass plies to form a sealed insulating glass unit.

Protective Glazing Applications

Security — For many years laminated glass has been used in low-to-medium level security applications. Note that certain Viracon laminated products comply with U.L. 972 Burglary Resistant Glazing Material requirements. Insure-Lite 516 and 916 feature U.L. 972 listing for burglary resistant glazing.

Windborne Debris — Viracon offers laminated glass products to protect building interiors from the winds and rain associated with hurricanes. Laminated glass is a durable, high-performance glazing that provides glass retention in the opening if the glass is broken due to the impact of flying debris.

Bomb Blast — Laminated glass offers protection when a building is exposed to the threat of explosives. Tests have shown that when windows glazed with laminated glass are subjected to a blast impulse, broken glass fragments tend to adhere to the plastic interlayer rather than spraying building occupants with harmful glass shards or other debris.

ENERGY TERMS

Visible Light Transmittance

The percentage of visible light (380 - 780 nm) that is transmitted through the glass.

Solar Transmittance

The percentage of ultraviolet, visible and near infrared energy (300 - 3000 nm) that is transmitted through the glass.

Visible Light Reflectance

The percentage of light that is reflected from the glass surface(s).

Solar Reflectance

The percentage of solar energy that is reflected from the glass surface(s).

NFRC U-Value

A measure of heat gain or heat loss through glass due to the differences between indoor and outdoor temperatures. These are center pane values based on NFRC standard winter nighttime and summer daytime conditions.

U-values are given in BTU/(hr*ft²*°F) for the English system. Metric U-values are given in W/(m²*°K). To convert from English to metric, multiply the English U-value by 5.6783.

NFRC winter nighttime U-values are based on an outdoor temperature of 0°F (-17.8°C), an indoor temperature of 70°F (21°C) and a 12.3 mph (19.8 km/h) outdoor air velocity.

NFRC summer daytime U-values are based on an outdoor temperature of 89°F (32°C), an indoor temperature of 75°F (24°C), a 6.2 mph (10.1 km/h) outdoor air velocity and a solar intensity of 248 BTU/(hr*ft²*°F) (782 W/m²).

R-Value

Thermal resistance is expressed in ft²*hr*°F/BTU. It is the reciprocal of U-value. The higher the R-value, the less heat is transmitted through the glazing material.

Shading Coefficient

Shading coefficient is the ratio of solar heat gain through a specific type of glass that is relative to the solar heat gain through a 1/8" (3 mm) ply of clear glass under identical conditions (see Figure 8). As the shading coefficient number decreases, heat gain is reduced, which means a better performing product.

Relative Heat Gain (RHG)

The amount of heat gained through glass taking into consideration U-value and shading coefficient. Using the NFRC standard, relative heat gain is calculated as follows:

English System:
RHG = Summer U-value x 14°F + shading coefficient x 200.

Metric System:
RHG = Summer U-value x 7.8°C + shading coefficient x 630.

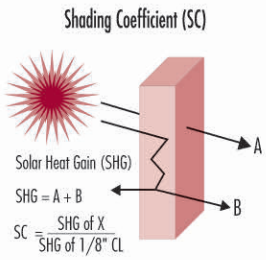


Figure 8

Solar Heat Gain Coefficient (SHGC)

The portion of directly transmitted and absorbed solar energy that enters into the building's interior. The higher the SHGC, the higher the heat gain.

Light to Solar Gain Ratio (LSG)

The ratio is equal to the Visible Light Transmittance divided by the Solar Heat Gain Coefficient. The Department of Energy's Federal Technology Alert publication of the Federal Energy Management Program (FEMP) views an LSG of 1.25 or greater to be Green Glazing/Spectrally Selective Glazing.

European U-Value (formerly K-Value)

Based on ISO-DP10292 draft standard conditions. It is based on an outdoor temperature of 5.5°C, an indoor temperature of 20.5°C and a 4.8 m/s outdoor air velocity.

The solar and optical data presented in this guide are center-of-glass data based on the National Fenestration Rating Council measurement standards. They were calculated using Lawrence Berkeley Laboratories (LBL) new WINDOW 5.2 software. In some cases performance data changed in comparison to previous versions of LBL's WINDOW program.

SOLARSCREEN™ CODE CHARTS

Coating Type	Outboard Glass Substrate		Nominal Visible Light Transmittance of Coating	
VS = Stainless Steel	1 = Clear*	9 = Versalux® Blue 2000	08 = 8%	30 = 30%
VT = Titanium	2 = Green*	10 = Versalux® Green 2000*	13 = 13%	35 = 35%
VA = Antique	3 = Gray*	11 = Arctic Blue™	14 = 14%	40 = 40%
VH = VH Series	4 = Bronze*	12 = Atlantica™	18 = 18%	42 = 42%
VY = Crystal Chrome	5 = Blue*	13 = Starphire™	20 = 20%	45 = 45%
	6 = Blue-Green*	14 = Caribia™	22 = 22%	50 = 50%
	7 = Azuria™*	15 = UltraWhite™		75 = 75%
	8 = EverGreen™			

*Detailed performance data is provided on the following pages with these glass substrates. Contact us for performance data with other glass substrates.

UNCOATED LAMINATED GLASS (TABLE 1)

Product	Transmittance			Reflectance			U-Value		Shading Coefficient	Relative Heat Gain	SHGC	LSG	European U-Value
	Visible	Solar	U-V	Vis-Out	Vis-In	Solar	Winter	Summer					
Clear	85%	62%	<1%	7%	7%	6%	.97	.88	.83	178	.72	1.18	5.4
Green	71%	38%	<1%	6%	6%	5%	.97	.88	.64	141	.55	1.29	5.4
Gray	43%	34%	<1%	5%	5%	5%	.97	.88	.62	135	.53	.80	5.4
Bronze	51%	39%	<1%	5%	5%	5%	.97	.88	.66	143	.56	.91	5.4
Blue	53%	36%	<1%	5%	5%	5%	.97	.88	.63	139	.54	.99	5.4
Blue-Green	73%	41%	<1%	6%	6%	5%	.97	.88	.67	147	.58	1.25	5.4
Azuria™	65%	28%	<1%	6%	6%	5%	.97	.88	.57	127	.49	1.33	5.4
Green 2000	64%	29%	<1%	6%	6%	5%	.97	.88	.58	128	.50	1.27	5.4

SHGC refers to Solar Heat Gain Coefficient.
LSG refers to Light to Solar Gain ratio.

1. The performance data for Table 1 applies to laminated glass constructed with two plies (clear inboard) of 1/4" (6 mm) glass and a .030" (.76 mm) clear pvb interlayer. Increasing the thickness of the pvb interlayer will have an insignificant effect on performance data.
2. The performance data for Tables 2 - 5 applies to laminated glass constructed with two plies (clear inboard) of 1/4" (6 mm) glass and a .030" (.76 mm) clear pvb interlayer. All coatings are applied to the second surface. Increasing the thickness of the pvb interlayer will have an insignificant effect on performance data.
3. If Solarscreen reflective coatings are applied to tinted glass, the glass must be heat treated. In this case, a .060" (1.5 mm) pvb interlayer may be required.
4. If Solarscreen reflective coatings are applied to clear glass, contact Viracon's Technical Services Department to determine the possibility of using annealed glass.
5. The Technical Services Department can also provide performance information on products not listed here.

SOLARSCREEN STAINLESS STEEL REFLECTIVE LAMINATED GLASS (TABLE 2)

Product	Transmittance			Reflectance			U-Value		Shading Coefficient	Relative Heat Gain	SHGC	LSG	European U-Value
	Visible	Solar	U-V	Vis-Out	Vis-In	Solar	Winter	Summer					
VS 1-08	8%	5%	<1%	42%	35%	34%	.97	.88	.29	70	.24	.33	5.4
VS 1-14	13%	9%	<1%	32%	36%	27%	.97	.88	.34	80	.29	.44	5.4
VS 1-20	19%	13%	<1%	24%	31%	21%	.97	.88	.39	91	.33	.58	5.4
VS 1-30	28%	19%	<1%	15%	27%	14%	.97	.88	.47	106	.40	.69	5.4
VS 1-40	38%	26%	<1%	10%	22%	9%	.97	.88	.54	121	.46	.82	5.4
VS 2-08	7%	3%	<1%	31%	35%	16%	.97	.88	.34	81	.29	.23	5.4
VS 2-14	11%	5%	<1%	24%	36%	13%	.97	.88	.37	86	.31	.35	5.4
VS 2-20	16%	8%	<1%	18%	31%	11%	.97	.88	.40	92	.34	.47	5.4
VS 2-30	23%	12%	<1%	12%	27%	8%	.97	.88	.44	99	.37	.63	5.4
VS 2-40	32%	16%	<1%	8%	22%	6%	.97	.88	.48	107	.41	.78	5.4
VS 3-08	4%	3%	<1%	14%	35%	13%	.97	.88	.35	82	.30	.13	5.4
VS 3-14	7%	5%	<1%	11%	36%	11%	.97	.88	.37	87	.32	.20	5.4
VS 3-20	10%	7%	<1%	9%	31%	9%	.97	.88	.39	91	.34	.28	5.4
VS 3-30	14%	10%	<1%	7%	27%	7%	.97	.88	.43	98	.36	.39	5.4
VS 3-40	19%	14%	<1%	6%	22%	6%	.97	.88	.46	105	.40	.48	5.4
VS 4-08	5%	3%	<1%	18%	35%	16%	.97	.88	.34	81	.29	.17	5.4
VS 4-14	8%	5%	<1%	15%	36%	13%	.97	.88	.37	86	.31	.25	5.4
VS 4-20	12%	8%	<1%	11%	31%	11%	.97	.88	.40	92	.34	.34	5.4
VS 4-30	17%	12%	<1%	8%	27%	8%	.97	.88	.44	100	.37	.45	5.4
VS 4-40	23%	16%	<1%	6%	22%	6%	.97	.88	.48	108	.41	.56	5.4
VS 5-08	5%	3%	<1%	19%	35%	15%	.97	.88	.35	82	.29	.17	5.4
VS 5-14	8%	5%	<1%	16%	36%	12%	.97	.88	.37	86	.31	.26	5.4
VS 5-20	12%	7%	<1%	12%	31%	10%	.97	.88	.40	91	.34	.35	5.4
VS 5-30	17%	11%	<1%	9%	27%	8%	.97	.88	.43	99	.37	.47	5.4
VS 5-40	24%	15%	<1%	7%	22%	6%	.97	.88	.47	106	.40	.59	5.4
VS 6-08	7%	4%	<1%	32%	35%	18%	.97	.88	.34	80	.28	.24	5.4
VS 6-14	11%	6%	<1%	25%	36%	15%	.97	.88	.37	86	.31	.35	5.4
VS 6-20	16%	9%	<1%	19%	31%	12%	.97	.88	.40	92	.34	.48	5.4
VS 6-30	24%	13%	<1%	12%	27%	9%	.97	.88	.44	100	.38	.62	5.4
VS 6-40	32%	17%	<1%	9%	22%	7%	.97	.88	.49	109	.42	.77	5.4
VS 7-08	6%	3%	<1%	27%	35%	13%	.97	.88	.35	82	.29	.21	5.4
VS 7-14	10%	4%	<1%	22%	36%	11%	.97	.88	.37	86	.31	.32	5.4
VS 7-20	15%	6%	<1%	16%	31%	9%	.97	.88	.39	90	.33	.45	5.4
VS 7-30	21%	9%	<1%	11%	27%	7%	.97	.88	.42	96	.36	.59	5.4
VS 7-40	29%	12%	<1%	8%	22%	6%	.97	.88	.45	102	.38	.77	5.4
VS 10-08	6%	3%	<1%	26%	35%	12%	.97	.88	.35	83	.30	.20	5.4
VS 10-14	10%	4%	<1%	20%	36%	10%	.97	.88	.37	87	.32	.30	5.4
VS 10-20	14%	6%	<1%	16%	31%	9%	.97	.88	.39	91	.33	.44	5.4
VS 10-30	21%	9%	<1%	10%	27%	7%	.97	.88	.42	97	.36	.58	5.4
VS 10-40	29%	12%	<1%	8%	22%	6%	.97	.88	.45	103	.39	.73	5.4

SOLARSCREEN ANTIQUE SILVER REFLECTIVE LAMINATED GLASS (TABLE 3)

Product	Transmittance			Reflectance			U-Value		Shading Coefficient	Relative Heat Gain	SHGC	LSG	European U-Value
	Visible	Solar	U-V	Vis-Out	Vis-In	Solar	Winter	Summer					
VA 1-13	14%	9%	<1%	28%	37%	24%	.97	.88	.36	84	.30	.47	5.4
VA 1-18	19%	13%	<1%	22%	34%	19%	.97	.88	.40	93	.34	.57	5.4
VA 1-22	21%	14%	<1%	19%	33%	17%	.97	.88	.42	96	.36	.59	5.4
VA 1-35	35%	25%	<1%	11%	28%	9%	.97	.88	.53	118	.45	.79	5.4
VA 2-13	12%	6%	<1%	21%	37%	12%	.97	.88	.38	88	.32	.37	5.4
VA 2-18	16%	8%	<1%	16%	34%	10%	.97	.88	.40	93	.34	.48	5.4
VA 2-22	18%	9%	<1%	15%	33%	9%	.97	.88	.41	95	.35	.51	5.4
VA 2-35	30%	15%	<1%	9%	28%	6%	.97	.88	.47	106	.40	.74	5.4
VA 3-13	7%	5%	<1%	10%	37%	10%	.97	.88	.38	88	.32	.22	5.4
VA 3-18	10%	7%	<1%	9%	34%	9%	.97	.88	.40	92	.34	.29	5.4
VA 3-22	11%	8%	<1%	8%	33%	8%	.97	.88	.41	94	.35	.31	5.4
VA 3-35	18%	13%	<1%	6%	27%	6%	.97	.88	.46	104	.39	.46	5.4
VA 4-13	9%	6%	<1%	13%	37%	12%	.97	.88	.38	88	.32	.27	5.4
VA 4-18	12%	8%	<1%	11%	34%	10%	.97	.88	.40	92	.34	.34	5.4
VA 4-22	13%	9%	<1%	10%	33%	9%	.97	.88	.41	95	.35	.37	5.4
VA 4-35	21%	16%	<1%	7%	27%	6%	.97	.88	.47	107	.40	.54	5.4
VA 5-13	9%	6%	<1%	14%	37%	11%	.97	.88	.38	88	.32	.28	5.4
VA 5-18	12%	7%	<1%	11%	34%	9%	.97	.88	.40	92	.34	.36	5.4
VA 5-22	13%	8%	<1%	10%	33%	9%	.97	.88	.41	94	.35	.38	5.4
VA 5-35	22%	14%	<1%	7%	27%	6%	.97	.88	.46	105	.40	.56	5.4
VA 6-13	12%	6%	<1%	21%	37%	13%	.97	.88	.38	88	.32	.38	5.4
VA 6-18	17%	9%	<1%	17%	34%	11%	.97	.88	.40	93	.34	.49	5.4
VA 6-22	18%	10%	<1%	15%	33%	10%	.97	.88	.41	95	.35	.52	5.4
VA 6-35	30%	16%	<1%	9%	28%	7%	.97	.88	.48	108	.41	.74	5.4
VA 7-13	11%	5%	<1%	19%	37%	10%	.97	.88	.38	88	.32	.34	5.4
VA 7-18	15%	6%	<1%	15%	34%	8%	.97	.88	.39	91	.33	.45	5.4
VA 7-22	17%	7%	<1%	14%	33%	8%	.97	.88	.40	92	.34	.49	5.4
VA 7-35	27%	11%	<1%	8%	28%	6%	.97	.88	.44	101	.38	.72	5.4
VA 10-13	11%	5%	<1%	18%	37%	9%	.97	.88	.38	88	.32	.33	5.4
VA 10-18	15%	6%	<1%	14%	34%	8%	.97	.88	.40	92	.34	.43	5.4
VA 10-22	16%	7%	<1%	13%	33%	7%	.97	.88	.40	93	.34	.47	5.4
VA 10-35	27%	12%	<1%	8%	28%	6%	.97	.88	.45	102	.38	.70	5.4

SOLARSCREEN CRYSTAL CHROME REFLECTIVE LAMINATED GLASS (TABLE 4)

Product	Transmittance			Reflectance			U-Value		Shading Coefficient	Relative Heat Gain	SHGC	LSG	European U-Value
	Visible	Solar	U-V	Vis-Out	Vis-In	Solar	Winter	Summer					
VY 1-08	7%	5%	<1%	43%	40%	35%	.97	.88	.28	69	.24	.30	5.4
VY 1-14	13%	9%	<1%	36%	35%	28%	.97	.88	.34	80	.29	.44	5.4
VY 1-20	19%	14%	<1%	27%	32%	20%	.97	.88	.40	93	.34	.56	5.4
VY 1-30	28%	21%	<1%	22%	25%	16%	.97	.88	.47	107	.41	.68	5.4
VY 2-08	6%	3%	<1%	32%	40%	17%	.97	.88	.34	80	.29	.21	5.4
VY 2-14	11%	6%	<1%	27%	35%	14%	.97	.88	.37	86	.31	.35	5.4
VY 2-20	16%	8%	<1%	21%	32%	11%	.97	.88	.40	92	.34	.47	5.4
VY 2-30	24%	13%	<1%	17%	25%	10%	.97	.88	.44	100	.37	.64	5.4
VY 3-08	4%	3%	<1%	14%	40%	13%	.97	.88	.35	82	.29	.12	5.4
VY 3-14	6%	5%	<1%	12%	35%	11%	.97	.88	.37	87	.32	.20	5.4
VY 3-20	10%	7%	<1%	10%	32%	9%	.97	.88	.40	92	.34	.28	5.4
VY 3-30	14%	11%	<1%	9%	24%	8%	.97	.88	.44	99	.37	.38	5.4
VY 4-08	4%	3%	<1%	18%	40%	17%	.97	.88	.34	80	.29	.15	5.4
VY 4-14	8%	6%	<1%	16%	35%	14%	.97	.88	.37	86	.31	.25	5.4
VY 4-20	12%	9%	<1%	13%	32%	11%	.97	.88	.40	93	.34	.34	5.4
VY 4-30	17%	13%	<1%	11%	24%	9%	.97	.88	.44	101	.38	.44	5.4
VY 5-08	5%	3%	<1%	20%	40%	15%	.97	.88	.34	81	.29	.16	5.4
VY 5-14	8%	5%	<1%	17%	35%	13%	.97	.88	.37	86	.31	.26	5.4
VY 5-20	12%	8%	<1%	13%	32%	10%	.97	.88	.40	92	.34	.35	5.4
VY 5-30	18%	12%	<1%	12%	24%	9%	.97	.88	.44	100	.37	.48	5.4
VY 6-08	6%	3%	<1%	33%	40%	18%	.97	.88	.33	79	.28	.22	5.4
VY 6-14	11%	6%	<1%	28%	35%	16%	.97	.88	.36	85	.31	.35	5.4
VY 6-20	16%	9%	<1%	21%	32%	12%	.97	.88	.40	92	.34	.48	5.4
VY 6-30	24%	14%	<1%	18%	25%	10%	.97	.88	.44	101	.38	.63	5.4
VY 7-08	6%	2%	<1%	28%	40%	13%	.97	.88	.35	82	.29	.19	5.4
VY 7-14	10%	4%	<1%	24%	35%	12%	.97	.88	.37	86	.31	.32	5.4
VY 7-20	15%	6%	<1%	18%	32%	10%	.97	.88	.39	90	.33	.45	5.4
VY 7-30	22%	9%	<1%	15%	25%	9%	.97	.88	.42	96	.35	.62	5.4
VY 10-08	5%	2%	<1%	26%	41%	12%	.97	.88	.35	82	.30	.18	5.4
VY 10-14	10%	4%	<1%	22%	36%	11%	.97	.88	.37	86	.31	.31	5.4
VY 10-20	14%	7%	<1%	17%	32%	9%	.97	.88	.39	91	.34	.42	5.4
VY 10-30	21%	10%	<1%	15%	25%	8%	.97	.88	.42	97	.36	.58	5.4

SOLARSCREEN TITANIUM BLUE REFLECTIVE LAMINATED GLASS (TABLE 5)

Product	Transmittance			Reflectance			U-Value		Shading Coefficient	Relative Heat Gain	SHGC	LSG	European U-Value
	Visible	Solar	U-V	Vis-Out	Vis-In	Solar	Winter	Summer					
VT 1-20	20%	12%	<1%	22%	31%	22%	.97	.88	.39	89	.33	.60	5.4
VT 1-30	29%	18%	<1%	16%	28%	16%	.97	.88	.46	104	.39	.74	5.4
VT 1-40	38%	26%	<1%	11%	23%	11%	.97	.88	.53	119	.46	.83	5.4
VT 2-20	17%	8%	<1%	17%	31%	11%	.97	.88	.40	92	.34	.49	5.4
VT 2-30	24%	12%	<1%	13%	28%	9%	.97	.88	.43	99	.37	.65	5.4
VT 2-40	32%	16%	<1%	9%	23%	7%	.97	.88	.47	107	.40	.81	5.4
VT 3-20	10%	6%	<1%	9%	31%	10%	.97	.88	.39	91	.33	.30	5.4
VT 3-30	15%	10%	<1%	7%	27%	8%	.97	.88	.43	97	.36	.40	5.4
VT 3-40	19%	14%	<1%	6%	23%	6%	.97	.88	.46	105	.39	.49	5.4
VT 4-20	12%	8%	<1%	11%	31%	11%	.97	.88	.39	91	.33	.36	5.4
VT 4-30	17%	12%	<1%	9%	27%	9%	.97	.88	.43	99	.37	.47	5.4
VT 4-40	23%	16%	<1%	7%	23%	7%	.97	.88	.48	108	.41	.57	5.4
VT 5-20	13%	7%	<1%	12%	31%	10%	.97	.88	.39	91	.33	.38	5.4
VT 5-30	18%	11%	<1%	9%	27%	8%	.97	.88	.43	98	.37	.49	5.4
VT 5-40	24%	15%	<1%	7%	23%	7%	.97	.88	.47	106	.40	.60	5.4
VT 6-20	17%	8%	<1%	18%	31%	12%	.97	.88	.40	92	.34	.50	5.4
VT 6-30	25%	13%	<1%	13%	28%	9%	.97	.88	.44	100	.37	.66	5.4
VT 6-40	33%	17%	<1%	10%	23%	7%	.97	.88	.48	109	.41	.80	5.4
VT 7-20	15%	6%	<1%	16%	31%	9%	.97	.88	.39	90	.33	.46	5.4
VT 7-30	22%	9%	<1%	12%	28%	8%	.97	.88	.42	96	.35	.63	5.4
VT 7-40	30%	12%	<1%	9%	23%	6%	.97	.88	.45	101	.38	.78	5.4
VT 10-20	15%	6%	<1%	15%	32%	8%	.97	.88	.39	91	.33	.45	5.4
VT 10-30	22%	9%	<1%	11%	28%	7%	.97	.88	.42	96	.36	.60	5.4
VT 10-40	29%	12%	<1%	8%	23%	6%	.97	.88	.45	102	.38	.76	5.4

SOLARSCREEN VH SERIES LAMINATED GLASS (TABLE 6)

Product	Transmittance			Reflectance			U-Value		Shading Coefficient	Relative Heat Gain	SHGC	LSG	European U-Value
	Visible	Solar	U-V	Vis-Out	Vis-In	Solar	Winter	Summer					
VH 11-75	81%	48%	<1%	9%	9%	19%	.97	.88	.67	147	.58	1.40	5.4
VH 11-50	53%	33%	<1%	15%	8%	19%	.97	.88	.55	123	.48	1.11	5.4
VH 11-45	50%	29%	<1%	10%	13%	21%	.97	.88	.52	115	.44	1.14	5.4
VH 11-42	40%	25%	<1%	18%	11%	20%	.97	.88	.49	110	.42	.95	5.4
VH 11-40	39%	22%	<1%	15%	16%	25%	.97	.88	.45	102	.38	1.02	5.4
VH 12-75	68%	32%	<1%	9%	8%	18%	.97	.88	.55	122	.47	1.46	5.4
VH 12-50	45%	21%	<1%	14%	7%	19%	.97	.88	.47	106	.40	1.13	5.4
VH 12-45	42%	19%	<1%	10%	10%	21%	.97	.88	.44	100	.38	1.11	5.4
VH 12-42	34%	16%	<1%	18%	9%	20%	.97	.88	.42	96	.36	.94	5.4
VH 12-40	33%	14%	<1%	14%	13%	25%	.97	.88	.39	90	.33	.98	5.4
VH 13-75	41%	26%	<1%	7%	6%	18%	.97	.88	.51	113	.43	.95	5.4
VH 13-50	27%	18%	<1%	14%	5%	19%	.97	.88	.44	100	.38	.71	5.4
VH 13-45	25%	15%	<1%	9%	6%	21%	.97	.88	.42	95	.35	.72	5.4
VH 13-42	20%	13%	<1%	18%	6%	20%	.97	.88	.40	93	.34	.59	5.4
VH 13-40	20%	11%	<1%	14%	7%	25%	.97	.88	.37	86	.31	.62	5.4
VH 14-75	49%	30%	<1%	8%	6%	18%	.97	.88	.54	120	.46	1.07	5.4
VH 14-50	32%	21%	<1%	14%	6%	19%	.97	.88	.46	104	.39	.82	5.4
VH 14-45	30%	18%	<1%	10%	7%	21%	.97	.88	.43	99	.37	.82	5.4
VH 14-42	24%	15%	<1%	18%	7%	20%	.97	.88	.42	96	.36	.67	5.4
VH 14-40	23%	13%	<1%	14%	8%	25%	.97	.88	.38	89	.33	.72	5.4
VH 15-75	51%	29%	<1%	8%	6%	18%	.97	.88	.53	118	.45	1.14	5.4
VH 15-50	34%	20%	<1%	14%	6%	19%	.97	.88	.45	103	.39	.86	5.4
VH 15-45	31%	17%	<1%	10%	8%	21%	.97	.88	.43	98	.37	.85	5.4
VH 15-42	25%	15%	<1%	18%	7%	20%	.97	.88	.41	95	.35	.72	5.4
VH 15-40	24%	13%	<1%	14%	9%	25%	.97	.88	.38	88	.32	.75	5.4
VH 16-75	70%	34%	<1%	9%	8%	18%	.97	.88	.56	125	.49	1.42	5.4
VH 16-50	46%	23%	<1%	14%	7%	19%	.97	.88	.48	108	.41	1.12	5.4
VH 16-45	43%	20%	<1%	10%	11%	21%	.97	.88	.45	103	.39	1.10	5.4
VH 16-42	34%	17%	<1%	18%	9%	20%	.97	.88	.43	99	.37	.93	5.4
VH 16-40	33%	15%	<1%	14%	13%	25%	.97	.88	.40	92	.34	.98	5.4
VH 17-75	63%	25%	<1%	8%	7%	18%	.97	.88	.50	112	.43	1.46	5.4
VH 17-50	42%	17%	<1%	14%	6%	19%	.97	.88	.43	99	.37	1.12	5.4
VH 17-45	39%	15%	<1%	10%	10%	21%	.97	.88	.41	95	.35	1.11	5.4
VH 17-42	31%	13%	<1%	18%	8%	20%	.97	.88	.40	92	.34	.91	5.4
VH 17-40	30%	11%	<1%	14%	12%	25%	.97	.88	.37	86	.31	.96	5.4
VH 110-75	61%	25%	<1%	8%	7%	18%	.97	.88	.50	112	.43	1.42	5.4
VH 110-50	40%	17%	<1%	14%	6%	19%	.97	.88	.43	99	.37	1.09	5.4
VH 110-45	38%	15%	<1%	10%	9%	21%	.97	.88	.41	95	.35	1.08	5.4
VH 110-42	30%	13%	<1%	18%	8%	20%	.97	.88	.40	92	.34	.89	5.4
VH 110-40	29%	11%	<1%	14%	11%	25%	.97	.88	.36	86	.32	.92	5.4

1. The performance data for Table 6 applies to laminated glass constructed with two plies (clear outboard) of 1/4" (6 mm) glass and one ply of .030" (.76 mm) clear pvb interlayer. All coatings are applied to the second surface. If tinted glass is used, it is installed to the interior of the building. Increasing the thickness of the pvb interlayer will have an insignificant effect on performance data.
2. If Solarscreen VH Series laminates are supplied with tinted glass, the glass must be heat treated.
3. The Technical Services Department can also provide performance information on products not listed here.

Setting Block Location
Weep Hole Location

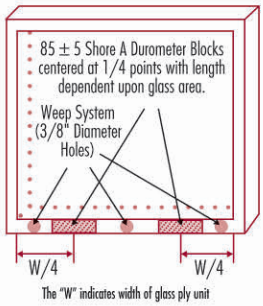


Figure 9

Clearance, Bite and
Dimensional Tolerances

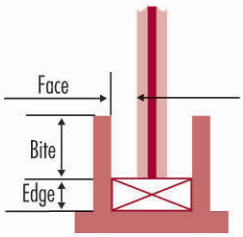


Figure 10

Typical Glazing Detail

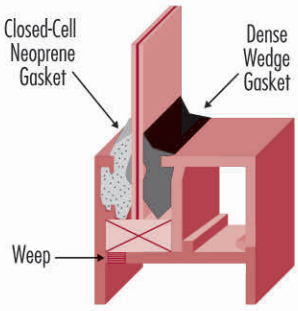


Figure 11

Glazing Guidelines

All glass plies must be supported on two silicone or silicone compatible setting blocks. The blocks should have a durometer hardness of 85±5. They should also be centered at quarter points and be 1/16" (1.6 mm) less than the channel width (see Figure 9).

Lockstrip gasket systems also require setting blocks. For additional recommendations, contact the appropriate gasket manufacturer.

Inadequate edge clearances can cause glass breakage as a result of glass-to-metal contact. Viracon recommends a minimum face clearance of 1/8" (3 mm) and a minimum edge clearance of 1/4" (6 mm) (see Figure 10). For minimum glass bite and tolerance levels, see chart below.

Weep System

Do not expose the edges of laminated, insulating and opacifier film glass to standing water. This can cause premature seal failure or delamination. Viracon requires either impervious weather seals or an adequate weep system to prevent this from occurring (see Figure 11). This is also true of lockstrip gasket glazing.

The glazing system manufacturer or designer is ultimately responsible for the design of the weep system and its proper performance.

Structural Silicone Glazing

Structural silicone glazing systems use silicone sealants with an interior backup mullion. It must be specified as a structural silicone glazing system due to compatibility limitations of silicone sealants with certain glass types or insulating unit secondary seals. To obtain approval for any structural silicone glazing system, contact the appropriate silicone manufacturer or Viracon's Technical Services Department.

Glass Handling and Storage

Care needs to be taken during handling and glazing to ensure that glass damage does not occur. Do not allow glass edges to contact the frame or any hard surface during installation. Use rolling blocks if the laminated units are rotated or "cartwheeled" on their corners. To see an example of a rolling block, refer to the Glass Association of North America (GANA) glazing manual.

Improper glass storage techniques may result in damage to glass components, glass surfaces, coatings or glass breakage. Store glass crates properly to prevent them from tipping. Also, ensure proper blocking and protection from outside elements.

Viracon recommends a 5-7° lean against two wide, sturdy uprights, which are capable of withstanding crate weight.

Once the glass is installed, the architect, general contractor or building owner should provide for glass protection and cleaning. Weathering metals, alkaline materials or abrasive cleaners may cause surface damage. Windblown objects, welding sparks or other material that contacts the glass surface during construction may cause irreversible damage.

Maintenance and Cleaning

To maintain aesthetics, it is important to clean the glass during and after construction. For routine cleaning, use a soft, clean, grit-free cloth and a mild soap, detergent, or window cleaning solution.

Rinse immediately with clean water and remove any excess water from the glass surface with a squeegee. Do not allow any metal or hard parts of the cleaning equipment to contact the glass surface.

Take special care cleaning coated reflective glass surfaces. Do not use abrasive cleaners, razor blades, putty knives and metal parts of cleaning equipment, since these will scratch the reflective coating. Fingerprints, grease, smears, dirt, scum and sealant residue are more noticeable on reflective glass, requiring more frequent cleaning. Follow the same cleaning techniques used for nonreflective glass.

Glass Breakage

It is important to first determine appropriate loads for the glass. Viracon can supply architects with glass strength analyses on specified products. "Unexplained" glass breakage may still occur due to thermal stress, glazing system pressures, glazing damage, handling and storage conditions, excessive wind loads, objects and debris striking the glass, improper factory fabrication or damage by persons or objects at the construction site.

Framing Deflections

Refer to the GANA glazing manual for information on adequate framing systems. You are required to comply with industry standards for framing deflection. It must not exceed either the length of the span divided by 175 or 3/4" (19 mm), whichever is less.

Non-Rectangular Glass Shapes

Viracon's capabilities include cutting virtually any shape glass required for your project without full-size patterns. However, if you require a full-size pattern, it must be submitted to Viracon on mylar material. If not, Viracon will transfer the pattern to mylar at an additional charge. However, Viracon will not be responsible for size accuracy. For additional information, contact Viracon's Inside Sales Department.

Suggested Specifications

You can specify Viracon products, using the MASTERSPEC® Basic Section "Glass and Glazing" or the MASTERSPEC Supplemental Section "Decorative Glazing" software.

MASTERSPEC is a comprehensive and unbiased master specification system produced and distributed by the American Institute of Architects (AIA) on a licensed user basis. For further information, call 800-424-5080.

Warranty Information

Viracon's architectural products carry limited warranties. Contact our Inside Sales Department for copies of our product warranties.

PRODUCT STANDARDS

Uncoated Laminated Glass

Minimum Size	Standard Maximum Size*
Annealed:	
6" x 6"	84" x 144"
(152 mm x 152 mm)	(2134 mm x 3658 mm)
Heat processed:	
12" x 36"	84" x 144"
(305 mm x 914 mm)	(2134 mm x 3658 mm)

Premium over-sized maximum: 84" x 165" (2134 mm x 4191 mm) or 96" x 144" (2438 mm x 3658 mm). Premium over-sized maximum for silk-screened glass and for heat-soaked glass is 84" x 165" (2134 mm x 4191 mm). A technical review is required for all over-sized requests.

1. Viracon's architectural laminated glass products with a minimum .030" pvb interlayer comply with ANSI Z97.1-1984 and CPSC 16 CFR 1201, which are the industry safety standards for glazing materials.

2. In some cases, Viracon's laminated glass may require heat processing. For additional product information, refer to the heat processing section of this brochure.

Solarscreen High-Performance Reflective and VH Coated Laminated Glass

Minimum Size	Standard Maximum Size*
Heat processed:	
12" x 36"	84" x 144"
(305 mm x 914 mm)	(2134 mm x 3658 mm)

Premium over-sized maximum: 84" x 165" (2134 mm x 4191 mm) or 96" x 144" (2438 mm x 3658 mm). Premium over-sized maximum for silk-screened glass and for heat-soaked glass is 84" x 165" (2134 mm x 4191 mm). A technical review is required for all over-sized requests.

1. Coated Glass Inspection Guidelines. Viracon's coated glass products comply with ASTM Standard C 1376.

- Pinholes—Inspect glass from a distance of 10 ft. (3 m) in transmission, at a viewing angle of 90° to the specimen, against a bright uniform background. If a pinhole is readily apparent, the following criteria apply: Pinholes larger than 1/16" (1.6 mm) in diameter are not allowed in 80 percent of the central glass area. Pinholes larger than 3/32" (2.4 mm) are not allowed in the outer 20 percent of the glass area. No more than two readily apparent blemishes are allowed in a 3" (75 mm) diameter circle and no more than five readily apparent blemishes are allowed in a 12" (300 mm) diameter circle.

RECOMMENDED CLEARANCES

Glass Thickness	Edge Clearance	Face Clearance	Glass Bite	Dimensional Tolerance	Thickness Tolerance*
1/4" (6 mm) laminate with 1/8" (3 mm) glass	1/4" (6 mm)	1/8" (3 mm)	3/8" (10 mm)	+3/16"/-1/16" (4.8 mm/-1.6 mm)	.259"- .300" (6.6 mm/-7.6 mm)
1/2" (12 mm) laminate with 1/4" (6 mm) glass	1/4" (6 mm)	1/8" (3 mm)	1/2" (13 mm)	+3/16"/-1/16" (4.8 mm/-1.6 mm)	.467"- .520" (11.9 mm/-13.2 mm)

*Thickness tolerances for laminated glass use a .030" (.76 mm) pvb interlayer.

- Uniformity—When viewing coated glass from a minimum distance of 10 ft. (3 m), color variation may occur from one unit to another. This can be caused by variations within the float glass substrate and normal production variations and this is not considered a defect. All Viracon commercial glass products conform to industry color standards.
- Distortion—Various factors involved in heat processing, insulating air spacers and frame binding may distort reflected objects viewed on the glass surface. These are not considered defects of the coated glass or the final fabricated product.
- Scratches—Inspect glass from a distance of 10 ft. (3 m). Scratches up to 2" (50 mm) are allowed in 80 percent central glass area, and scratches up to 3" (75 mm) are allowed in the outer area. Concentrated scratches or abraded areas are not allowed.

Heat-Processed Glass (Heat Strengthened and Tempered)

1. Glass cutting and fabrication is completed prior to heat processing.
2. Viracon's two types of heat-processed glass comply with ASTM Standard C1048. Surface compression of heat-strengthened glass with thicknesses of 1/4" (6 mm) and less is 4,000-7,000 psi. Surface compression for 5/16" (8 mm) and 3/8" (10 mm) heat-strengthened glass is 5,000-8,00 psi.* For fully-tempered glass, the minimum surface compression is 10,000 psi. It also complies with ANSI Z97.1 and CPSC 16 CFR 1201 safety glazing standards.

*Because of reader repeatability and instrument tolerances, Viracon's tolerance for heat-strengthened glass surface compression is +/- 1,000 psi.

***Note: The maximum sizes listed above are shown to illustrate production limits. These sizes are unavailable as finished products. Maximum piece size for annealed glass under any condition is 50 sq. ft. (4.65 sq.m.). Maximum size for heat-treated glass under any condition is 65 sq. ft. (6.04 sq.m.), vertical application, and 40 sq. ft. (3.70 sq.m.) for sloped glazing. Maximum unit weight is 750 pounds (340 kg).**

For more information on laminated glass or additional literature, call 800-533-2080.

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We also work with professional organizations and firms worldwide to provide AIA accredited educational seminars. As a registered provider with the AIA/Continuing Education System (AIA/CES), architects can receive 1.5 continuing learning units (LU's) with AIA/CES, including health, safety and welfare credits. You can schedule a presentation by visiting our web site at www.viracon.com or by calling 800-533-2080.

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This publication describes Viracon's architectural laminated glass products to help you analyze possible design options and applications. To obtain warranty information, contact Viracon's Architectural Inside Sales or Technical Services Department.

The information contained in this publication is presented in good faith. It is believed to be accurate at the time of publication. Viracon reserves the right to change product specifications without notice and without incurring obligation.

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