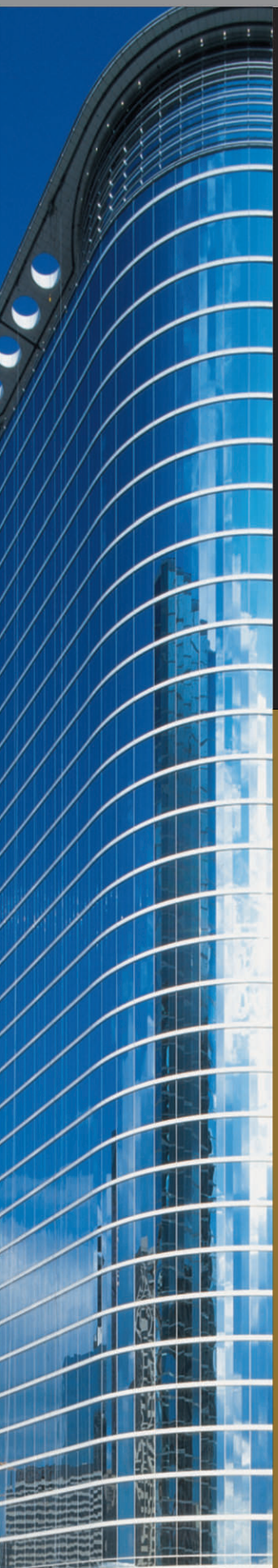
VIRACON



monolithic glass specs & tech

bringing the sun inside and other cool ideas

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 monolithic 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 monolithic glass using tints, silkscreened ceramic frit patterns and the high-performance coatings 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 monolithic glass ideas, we're really bright. Challenge us, you'll see.

Howard Hughes Center

Los Angeles, CA

Architect: DMJMH+N

Glazing Contractor: Walters & Wolf

Photographer: Tim Griffith

M

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.

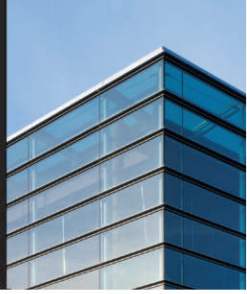
viraconsulting™

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.



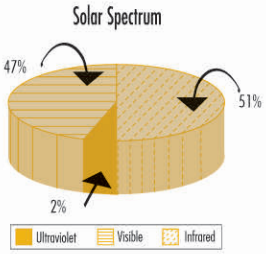


Figure 1

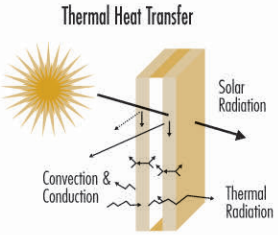


Figure 2

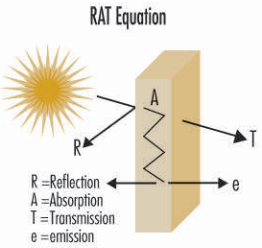


Figure 3

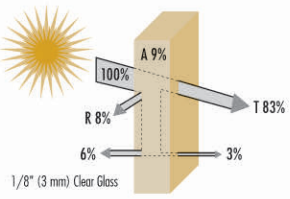


Figure 4

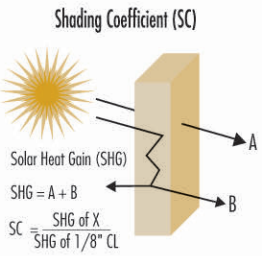


Figure 5

TERMS and DEFINITIONS

Float Glass

Viracon uses clear and tinted float glass from all the major U.S. float glass manufacturing companies. In the float glass process, the molten glass is introduced to a molten tin bath.

The glass floats on the tin and spreads, seeking a controlled level. Controlled heating allows the glass to flow, forming a flat ribbon of uniform thickness while on the tin bath. After the tin bath, the glass is slowly cooled; then, it is fed off the molten tin into the annealing lehr for further cooling. The glass thickness varies by changing the speed at which the glass ribbon moves into the annealing lehr.

The float glass process was developed in the early 1900s. Due to technical problems, its development was delayed. In 1959, Pilkington Brothers Ltd., England, introduced float glass for commercial uses. Today, there are three types of flat glass manufactured in the U.S.: sheet, float and rolled. Float glass accounts for over 98 percent of the flat glass currently being produced in the U.S. It is the fundamental building block in the world of fabricating architectural glass.

Solar Spectrum

The solar spectrum, commonly referred to as sunlight, consists of ultraviolet light (UV), visible light and infrared (IR). The energy distribution within the solar spectrum is approximately 2 percent UV, 47 percent visible light and 51 percent IR (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 is invisible to the human eye and has a wavelength range of ~300 - 380 nm. The damaging effects on long-term UV 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 is invisible to the human eye, has a wavelength range of ~790 - 3000 nm and has a penetrating heat effect. Short-wave IR 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.

Monolithic Glass

Today, glass is used for building construction to fulfill many design and performance requirements. Some of these include allowing natural daylight into the building while reducing unwanted heat gain.

Viracon's Solarscreen™ High-Performance Reflective Monolithic Glass

This type of glass combines the advantages of clear or tinted glass with the superior control characteristics of Solarscreen reflective coatings.

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 5). 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.

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 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%
VY = Crystal Chrome	4 = Bronze*	12 = Atlantica™	18 = 18%	42 = 42%
	5 = Blue*	13 = Starphire™	20 = 20%	
	6 = Blue-Green*	14 = Caribia™	22 = 22%	
	7 = Azuria™*	15 = UltraWhite™		
	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 MONOLITHIC 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	88%	77%	63%	8%	8%	7%	1.02	0.92	.94	201	.82	1.08	5.7
Green	77%	47%	30%	7%	7%	5%	1.03	0.93	.71	155	.61	1.26	5.7
Gray	47%	45%	24%	5%	5%	5%	1.02	0.93	.70	152	.60	.78	5.7
Bronze	53%	49%	24%	5%	5%	5%	1.02	0.92	.72	157	.62	.86	5.7
Blue	57%	47%	33%	6%	6%	5%	1.02	0.92	.71	155	.61	.93	5.7
Blue-Green	76%	49%	32%	7%	7%	6%	1.02	0.93	.73	158	.63	1.20	5.7
Azuria	68%	32%	42%	6%	6%	5%	1.02	0.93	.60	132	.51	1.34	5.7
Green 2000	66%	33%	15%	6%	6%	5%	1.02	0.93	.60	134	.52	1.27	5.7

*SHGC refers to Solar Heat Gain Coefficient.

SOLARSCREEN TITANIUM BLUE REFLECTIVE MONOLITHIC 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					
VT 1-20	21%	14%	8%	22%	33%	22%	.83	.71	.35	80	.30	.70	4.6
VT 1-30	30%	22%	13%	16%	28%	16%	.87	.76	.45	100	.38	.79	4.9
VT 1-40	40%	31%	19%	11%	23%	10%	.93	.83	.55	122	.47	.86	5.2
VT 2-20	18%	9%	4%	17%	33%	11%	.83	.71	.34	78	.29	.61	4.6
VT 2-30	26%	13%	6%	12%	28%	9%	.87	.76	.40	90	.34	.75	4.9
VT 2-40	34%	19%	9%	9%	22%	7%	.93	.83	.46	104	.39	.87	5.2
VT 3-20	11%	9%	4%	9%	32%	11%	.83	.71	.33	77	.28	.38	4.6
VT 3-30	15%	13%	6%	7%	28%	9%	.87	.76	.40	90	.34	.45	4.9
VT 3-40	21%	19%	9%	6%	22%	7%	.93	.83	.46	104	.40	.51	5.2
VT 4-20	13%	9%	3%	11%	33%	12%	.83	.71	.34	78	.29	.44	4.6
VT 4-30	19%	14%	5%	9%	28%	9%	.87	.76	.40	91	.34	.54	4.9
VT 4-40	25%	20%	7%	7%	22%	7%	.93	.83	.48	107	.41	.61	5.2
VT 5-20	13%	8%	4%	11%	33%	10%	.83	.71	.34	77	.28	.46	4.6
VT 5-30	19%	13%	7%	9%	28%	8%	.87	.76	.39	89	.33	.56	4.9
VT 5-40	25%	18%	10%	7%	22%	6%	.93	.83	.46	103	.39	.64	5.2
VT 6-20	18%	10%	4%	17%	33%	12%	.83	.71	.34	78	.29	.61	4.6
VT 6-30	26%	15%	7%	12%	28%	9%	.87	.76	.40	92	.34	.75	4.9
VT 6-40	34%	20%	10%	9%	22%	7%	.93	.83	.47	106	.40	.86	5.2
VT 7-20	16%	7%	6%	15%	32%	9%	.83	.71	.33	75	.27	.59	4.6
VT 7-30	23%	10%	9%	12%	28%	8%	.87	.76	.37	85	.31	.75	4.9
VT 7-40	31%	14%	13%	8%	22%	6%	.93	.83	.42	96	.36	.86	5.2
VT 10-20	16%	7%	2%	15%	32%	8%	.82	.71	.33	76	.28	.56	4.6
VT 10-30	23%	10%	3%	11%	28%	7%	.87	.76	.38	86	.32	.70	4.9
VT 10-40	30%	14%	4%	8%	22%	6%	.93	.82	.43	97	.36	.84	5.2

VIRACON

SOLARSCREEN STAINLESS STEEL REFLECTIVE MONOLITHIC 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					
VS 1-08	8%	7%	4%	42%	37%	34%	.76	.63	.23	55	.20	.42	4.3
VS 1-14	14%	11%	8%	32%	38%	27%	.80	.68	.30	69	.25	.54	4.5
VS 1-20	20%	15%	11%	24%	32%	21%	.86	.75	.37	84	.31	.65	4.8
VS 1-30	29%	23%	17%	15%	27%	13%	.91	.80	.47	105	.40	.73	5.1
VS 1-40	40%	32%	23%	9%	22%	9%	.96	.86	.57	126	.49	.81	5.4
VS 2-08	7%	4%	2%	31%	37%	17%	.76	.63	.26	61	.22	.32	4.3
VS 2-14	11%	6%	4%	25%	38%	14%	.80	.68	.30	70	.25	.45	4.5
VS 2-20	17%	9%	5%	18%	32%	11%	.86	.75	.35	80	.30	.56	4.8
VS 2-30	26%	15%	9%	12%	26%	8%	.91	.81	.42	96	.36	.73	5.1
VS 2-40	33%	19%	9%	8%	22%	6%	.96	.86	.47	107	.40	.83	5.4
VS 3-08	4%	4%	2%	14%	37%	15%	.76	.63	.26	61	.22	.19	4.3
VS 3-14	7%	6%	4%	12%	38%	13%	.80	.68	.30	70	.26	.26	4.5
VS 3-20	10%	9%	5%	10%	32%	11%	.86	.75	.35	81	.30	.34	4.8
VS 3-30	15%	12%	6%	7%	27%	7%	.91	.81	.41	93	.35	.42	5.1
VS 3-40	20%	17%	9%	6%	21%	6%	.96	.86	.46	105	.40	.50	5.4
VS 4-08	5%	4%	2%	17%	37%	16%	.76	.63	.26	61	.22	.22	4.3
VS 4-14	8%	7%	3%	14%	38%	13%	.80	.68	.30	70	.26	.30	4.5
VS 4-20	12%	9%	4%	11%	31%	11%	.86	.75	.35	81	.30	.39	4.8
VS 4-30	18%	14%	6%	8%	27%	8%	.91	.81	.42	95	.36	.49	5.1
VS 4-40	24%	20%	9%	6%	21%	6%	.96	.86	.49	109	.41	.58	5.4
VS 5-08	5%	4%	2%	19%	38%	14%	.76	.63	.26	62	.22	.23	4.3
VS 5-14	8%	6%	4%	15%	38%	12%	.80	.68	.30	70	.26	.32	4.5
VS 5-20	12%	9%	5%	12%	32%	10%	.86	.75	.35	80	.30	.41	4.8
VS 5-30	18%	13%	9%	8%	27%	8%	.91	.81	.41	93	.35	.52	5.1
VS 5-40	25%	18%	12%	6%	21%	6%	.96	.86	.47	106	.40	.62	5.4
VS 6-08	7%	4%	2%	31%	38%	18%	.76	.63	.26	60	.22	.32	4.3
VS 6-14	11%	7%	4%	25%	38%	15%	.80	.68	.30	70	.25	.46	4.5
VS 6-20	17%	10%	5%	18%	32%	12%	.86	.75	.35	81	.30	.56	4.8
VS 6-30	26%	16%	9%	11%	26%	8%	.91	.81	.43	97	.36	.72	5.1
VS 6-40	34%	21%	12%	8%	22%	6%	.96	.86	.49	109	.42	.81	5.4
VS 7-08	6%	3%	3%	27%	37%	13%	.76	.63	.26	61	.22	.29	4.3
VS 7-14	10%	5%	5%	22%	38%	11%	.80	.68	.29	68	.25	.42	4.5
VS 7-20	15%	7%	7%	16%	32%	9%	.86	.75	.34	78	.28	.55	4.8
VS 7-30	22%	10%	11%	11%	27%	7%	.91	.81	.39	88	.33	.68	5.1
VS 7-40	31%	14%	15%	8%	22%	6%	.96	.86	.43	99	.37	.82	5.4
VS 10-08	6%	3%	1%	26%	37%	12%	.76	.63	.26	62	.22	.29	4.3
VS 10-14	10%	5%	2%	20%	38%	10%	.80	.68	.30	69	.25	.40	4.5
VS 10-20	15%	7%	2%	15%	32%	9%	.86	.75	.34	79	.29	.52	4.8
VS 10-30	22%	10%	4%	10%	27%	7%	.91	.81	.43	89	.33	.66	5.1
VS 10-40	30%	14%	5%	7%	22%	5%	.96	.86	.44	100	.37	.80	5.4

SOLARSCREEN ANTIQUE SILVER REFLECTIVE MONOLITHIC 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					
VA 1-13	15%	11%	9%	28%	39%	24%	.81	.69	.32	73	.27	.55	4.6
VA 1-18	20%	16%	12%	21%	36%	19%	.86	.75	.38	86	.32	.63	4.8
VA 1-22	22%	18%	13%	19%	34%	17%	.86	.75	.40	90	.34	.66	4.8
VA 1-35	37%	31%	20%	10%	28%	9%	.94	.83	.55	121	.47	.79	5.2
VA 2-13	13%	7%	4%	21%	39%	12%	.81	.69	.31	73	.26	.48	4.6
VA 2-18	17%	9%	5%	16%	36%	10%	.86	.75	.36	82	.30	.57	4.8
VA 2-22	19%	10%	6%	15%	35%	9%	.86	.75	.37	84	.31	.61	4.8
VA 2-35	31%	18%	10%	8%	28%	6%	.94	.83	.46	103	.39	.81	5.2
VA 3-13	8%	7%	4%	11%	39%	12%	.81	.69	.32	73	.27	.28	4.6
VA 3-18	10%	9%	5%	9%	36%	10%	.86	.75	.36	82	.30	.34	4.8
VA 3-22	11%	11%	6%	8%	34%	9%	.86	.75	.37	84	.31	.37	4.8
VA 3-35	19%	19%	9%	6%	28%	6%	.94	.83	.46	104	.40	.48	5.2
VA 4-13	9%	7%	3%	12%	39%	12%	.81	.69	.32	73	.27	.32	4.6
VA 4-18	12%	10%	4%	10%	36%	10%	.86	.75	.36	82	.30	.39	4.8
VA 4-22	13%	11%	5%	9%	34%	9%	.86	.75	.37	84	.31	.42	4.8
VA 4-35	22%	19%	8%	6%	28%	6%	.94	.83	.47	105	.40	.55	5.2
VA 5-13	9%	7%	5%	13%	39%	11%	.81	.69	.32	73	.27	.34	4.6
VA 5-18	13%	9%	6%	11%	36%	9%	.86	.75	.35	81	.30	.42	4.8
VA 5-22	14%	10%	7%	10%	35%	9%	.86	.75	.37	84	.31	.45	4.8
VA 5-35	23%	18%	10%	7%	28%	6%	.94	.83	.46	103	.39	.59	5.2
VA 6-13	13%	7%	5%	21%	39%	13%	.81	.69	.32	73	.27	.47	4.6
VA 6-18	17%	10%	6%	17%	36%	11%	.86	.75	.36	82	.30	.57	4.8
VA 6-22	19%	11%	7%	15%	35%	10%	.86	.75	.37	85	.32	.59	4.8
VA 6-35	32%	20%	11%	8%	28%	7%	.94	.83	.47	106	.40	.79	5.2
VA 7-13	11%	5%	6%	18%	39%	10%	.81	.69	.31	71	.26	.44	4.6
VA 7-18	16%	7%	8%	15%	35%	8%	.86	.75	.34	79	.29	.54	4.8
VA 7-22	17%	8%	9%	13%	34%	8%	.86	.75	.35	80	.29	.59	4.8
VA 7-35	29%	13%	14%	8%	28%	6%	.94	.83	.42	96	.36	.79	5.2
VA 10-13	11%	5%	2%	17%	39%	9%	.81	.69	.31	72	.26	.43	4.6
VA 10-18	15%	7%	3%	14%	35%	8%	.86	.75	.34	79	.29	.52	4.8
VA 10-22	17%	8%	3%	13%	34%	7%	.86	.75	.35	81	.30	.56	4.8
VA 10-35	28%	13%	5%	8%	28%	6%	.94	.83	.43	97	.36	.77	5.2

SOLARSCREEN CRYSTAL CHROME REFLECTIVE MONOLITHIC 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					
VY 1-08	7%	6%	6%	43%	43%	35%	.76	.63	.23	54	.19	.39	4.2
VY 1-14	13%	11%	11%	36%	37%	28%	.81	.69	.30	70	.26	.52	4.6
VY 1-20	20%	17%	17%	27%	33%	20%	.87	.76	.39	88	.33	.61	4.9
VY 1-30	29%	26%	23%	22%	24%	16%	.95	.85	.49	101	.42	.70	5.3
VY 2-08	7%	4%	3%	33%	42%	17%	.76	.63	.26	61	.22	.31	4.2
VY 2-14	11%	7%	6%	27%	37%	15%	.81	.69	.31	71	.26	.43	4.6
VY 2-20	17%	10%	8%	21%	33%	11%	.87	.76	.36	83	.31	.55	4.9
VY 2-30	25%	15%	10%	17%	24%	10%	.95	.85	.43	98	.37	.66	5.3
VY 3-08	4%	3%	2%	14%	43%	13%	.76	.63	.27	62	.22	.17	4.2
VY 3-14	7%	6%	4%	12%	37%	11%	.81	.69	.31	72	.26	.25	4.6
VY 3-20	10%	9%	6%	10%	33%	9%	.87	.76	.36	83	.31	.32	4.9
VY 3-30	15%	14%	9%	9%	24%	8%	.95	.85	.43	98	.37	.40	5.3
VY 4-08	5%	4%	2%	18%	43%	16%	.76	.63	.26	61	.22	.21	4.2
VY 4-14	8%	7%	4%	15%	37%	13%	.81	.69	.31	72	.26	.31	4.6
VY 4-20	12%	10%	7%	13%	33%	11%	.87	.76	.37	84	.31	.37	4.9
VY 4-30	18%	16%	9%	11%	24%	9%	.95	.85	.44	101	.38	.46	5.3
VY 5-08	5%	4%	3%	19%	42%	15%	.76	.63	.26	62	.22	.22	4.2
VY 5-14	8%	7%	5%	17%	37%	13%	.81	.69	.31	72	.26	.32	4.6
VY 5-20	12%	10%	8%	13%	33%	10%	.87	.76	.36	84	.31	.40	4.9
VY 5-30	18%	15%	12%	11%	24%	9%	.95	.85	.43	98	.37	.50	5.3
VY 6-08	7%	4%	3%	32%	43%	17%	.76	.63	.26	60	.22	.30	4.2
VY 6-14	11%	7%	6%	27%	37%	15%	.81	.69	.31	71	.26	.43	4.6
VY 6-20	16%	10%	8%	21%	33%	12%	.87	.76	.36	83	.31	.53	4.9
VY 6-30	25%	17%	12%	17%	24%	10%	.95	.85	.44	100	.37	.68	5.3
VY 7-08	6%	3%	4%	30%	43%	14%	.76	.63	.26	60	.22	.28	4.2
VY 7-14	11%	5%	7%	25%	37%	12%	.81	.69	.30	70	.25	.43	4.6
VY 7-20	16%	8%	11%	20%	33%	10%	.87	.76	.35	80	.30	.55	4.9
VY 7-30	23%	11%	16%	15%	24%	9%	.95	.85	.40	92	.34	.66	5.3
VY 10-08	6%	3%	1%	26%	43%	12%	.76	.63	.26	61	.22	.25	4.2
VY 10-14	10%	5%	3%	22%	37%	11%	.81	.69	.30	70	.26	.38	4.6
VY 10-20	15%	7%	4%	17%	33%	9%	.87	.76	.35	80	.29	.52	4.9
VY 10-30	22%	11%	5%	14%	24%	8%	.95	.85	.40	93	.34	.64	5.3

1. The performance data for Table 1 applies to 1/4" (6 mm) glass.
2. Azuria and Green 2000 require heat treating.
3. The performance data for Tables 2 - 5 applies to 1/4" (6 mm) glass. All Solarscreen reflective coatings are applied to the second surface.
4. If Solarscreen reflective coatings are applied to tinted glass, the glass must be heat treated.
5. If Solarscreen reflective coatings are applied to clear glass, contact Viracon's Technical Services Department to determine the possibility of using annealed glass.
6. The Technical Services Department can also provide performance information on products not listed here.

VIRACON

Setting Block Location
Weep Hole Location

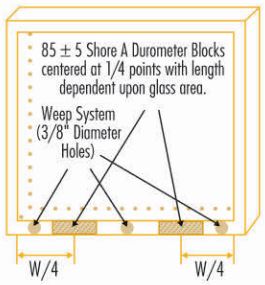


Figure 6

Clearance, Bite and
Dimensional Tolerances

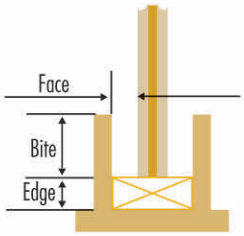


Figure 7

Typical Glazing Detail

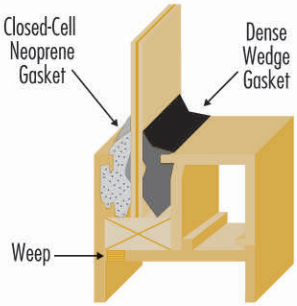


Figure 8

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 6).

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), a minimum edge clearance of 1/4" (6 mm) and a minimum glass bite of 3/8" (10 mm) (see Figure 7 and the chart on page 11).

Weep System

Do not expose the edges of monolithic glass with opacifier film to standing water. This can cause delamination. Viracon requires either impervious weather seals or an adequate weep system to prevent this from occurring (see Figure 8). 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 glass 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.

In addition, guideline specifications for Section 08810—Glass and additional Viracon product information is available through Sweets CD, McGraw-Hill's electronic complement to Sweets Catalog Files.

Warranty Information

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

PRODUCT STANDARDS

Uncoated Monolithic Heat-Processed Glass (Heat Strengthened and Tempered)

Minimum Size	Standard Maximum Size
1/4" (6 mm)	1/4" (6 mm)
12" x 12"	84" x 144"
(305 mm x 305 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. All Viracon heat-strengthened and tempered glass is horizontally processed.
2. Glass cutting and fabrication is completed prior to heat processing.
3. 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 5,000-8,000 psi.* For fully-tempered glass, the minimum surface compression is 10,000 psi. It complies with ANSI Z97.1 and CPSC 16 CFR 1201 safety glazing standards. *Because of reader readability and instrument tolerances, Viracon's tolerance for heat-strengthened glass surface compression is +/- 1,000 psi.
4. Heat-Treated Glass Characteristics
   - Distortion—Heat-strengthened or fully-tempered glass that is manufactured in a horizontal tempering furnace may contain slight surface waves caused by contact with the rollers. This waviness or roller wave distortion can be detected when viewing reflected images from a distance. Orientation of the glass in the furnace is critical in order to minimize the appearance of the roll wave distortion. It is recommended that the roller wave be oriented parallel to the horizontal glass dimension.
   - Flatness—Tempered and heat-strengthened glass products are not as flat as annealed glass due to processes used in manufacturing. For heat-treated glass products, the deviation for flatness is a function of thickness, width, length and other factors. Usually, increasing thickness yields flatter products.
   - Strain Pattern—For heat-strengthened and fully-tempered glass, a strain pattern or iridescence, which is not normally visible, can become visible under certain light conditions—especially polarized sky conditions. This is an inherent characteristic of heat-processed glass and should not be mistaken as discoloration or nonuniform tint or color. Strain pattern is a result of air quenching (cooling) of the glass and is not considered a defect.
   - Bow and Warp—Since heat-strengthened and tempered glass are reheated to their softening points and rapidly cooled, a certain amount of warp and bow is associated with each glass piece due to the resulting stress. Although warp and bow is not generally a significant factor to the design professional, it may appear as distorted reflected images under certain viewing conditions. For instance, it will be more noticeable in reflective glass. And, it is an inherent characteristic of heat-treated glass and is not considered a defect.
5. Viracon's sales and technical service support staff can help you determine which type of heat-processed glass is appropriate for your project:

Viracon offers two heavy duty choices: heat strengthened and fully tempered. Viracon's heat-strengthened glass provides superior resistance to thermal stress and wind/snow loading.

Heat-strengthened glass is approximately two times stronger than annealed glass. It is recommended for applications requiring strengthened glass. The exceptions are when safety glazing materials are required or when wind/snow loading conditions require fully-tempered glass.

Fully-tempered glass is approximately four times stronger than annealed glass. It provides superior resistance in high loading areas. Viracon can supply insulating glass units with both glass plies tempered for the following building applications:

RECOMMENDED CLEARANCES

Glass Thickness	Edge Clearance	Face Clearance	Glass Bite	Dimensional Tolerance	Thickness Tolerance*
1/4" (6 mm)	1/4" (6 mm)	1/8" (3 mm)	3/8" (10 mm)	+/-1/16" (+/-1.6 mm)	Per ASTM C1036

- Fire knockout panels.
- Safety glazing for use in openings with a walking surface on both sides, such as doors, side glass adjacent to doors, entrances, lobbies and balconies.
- The outboard glass ply of a sloped glazed insulating glass unit, providing that the inboard glass ply is a heat-strengthened laminate.

Viracon, or any other glass manufacturer, does not warrant the glass against breakage. Although Viracon does supply tempered glass for certain building applications and locations to comply with building code requirements, this should not be construed as a recommendation for use.

The use of tempered glass in any application has the associated risk of spontaneous breakage. Consequently, it is the responsibility of the building owner or design professional to consider the breakage potential when specifying the use of tempered glass.

Solarscreen High-Performance Reflective Monolithic 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. Solarscreen reflective glass products may require heat processing. Refer to heat processing comments on page 11 for further product information.
2. 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 12" (300 mm) diameter circle.
   - 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 of the central glass area and scratches up to 3" (75 mm) are allowed in the outer area. Concentrated scratches or abraded areas are not allowed.

Solarscreen Reflective Monolithic Spandrel Glass

Minimum Size	Standard Maximum Size
12" x 36"	83" x 144"
(305 mm x 914 mm)	(2108 mm x 3658 mm)

Premium over-sized maximum: 83" x 165" (2108 mm x 4191 mm). A technical review is required for all over-sized requests.

1. Spandrel glass with opacifier/scrim meets the requirements of ASTM C1048 for fallout protection if the glass breaks.
2. Viracon designs its spandrel glass for glazing against a uniform, opaque background. It is not recommended for use in transoms, partitions or other areas where a dark background is unavailable.
3. Reflective Monolithic Spandrel Glass Inspection Guidelines
   - View spandrel glass from a distance of 15 ft. (4.6 m) under daylight conditions. Color and reflectance may vary when viewed under a uniform, opaque background. This is not considered a defect.
   - When viewing spandrel glass under similar conditions, reflected pinholes and scratches are not considered defects if they are unobtrusive.

Viraspan™ for Uncoated Monolithic Glass

Minimum Size	Standard Maximum Size
12" x 12"	84" x 144"
(305 mm x 305 mm)	(2134 mm x 3658 mm)

Premium over-sized maximum: 84" x 165" (2134 mm x 4191 mm). A technical review is required for all over-sized requests.

1. Viracon designs its spandrel glass for glazing against a uniform, opaque background. It is not recommended for use in transoms, partitions or other areas where a dark background is unavailable.
2. Viraspan Spandrel Glass Inspection Guidelines
   - View spandrel glass from a distance of 15 ft. (4.6 m) under daylight conditions. Color and reflectance may vary when viewed under a uniform, opaque background. This is not considered a defect.
   - When viewing spandrel glass under similar conditions, reflected pinholes and scratches are not considered defects if they are unobtrusive.
3. You can use Viraspan in structurally glazed applications. However, a clear edge may be visible. Contact Viracon's Insides Sales Department for more information.
4. Viracon reserves the right to change substrate glass suppliers. As a result, this may affect perceived colors of our Viraspan samples. Approval of all glass colors is based on 12" x 12" (305 mm x 305 mm) samples, which are ordered for each project.

***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. Maximum unit weight is 750 pounds (340 kg).**

For more information on monolithic glass or additional literature, call 800-533-2080 (E-mail: glass@viracon.com).

CONTINUING EDUCATION

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 monolithic 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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