A USGlass METAL & GLAZING MAGAZINE Supplement

A GUIDE TO Glass Codes

YOUR GUIDE TO UNDERSTANDING:

- Energy Codes
- Safety Glazing Codes
- Wildlife Codes
- Fire Safety Codes
- And More

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Contents

On the Cover

The Daimler Trucks North America Headquarters in Portland, Ore., features Vitro Architectural Glass' Solarban® R100 Solarblue® glass fabricated by Hartung Glass and installed by Benson Industries.

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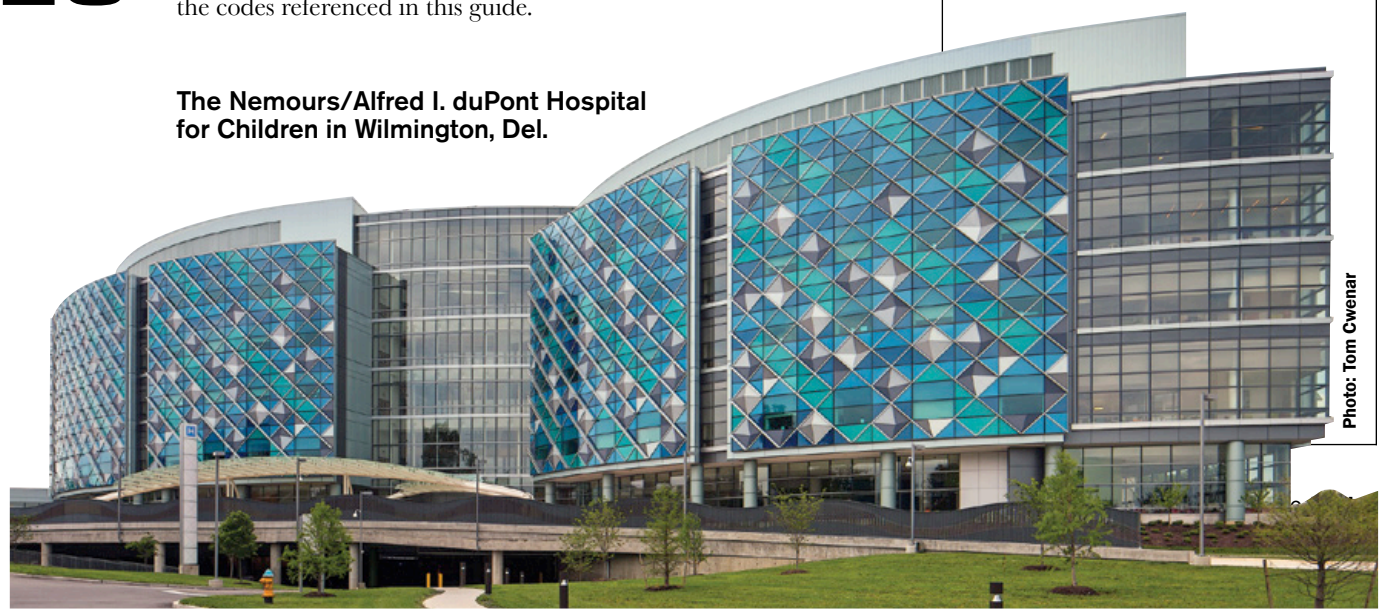


Photo: Tom Cwenar

Glass

Photo: Tom Kessler

Photo: Tom Kessler

It is both the artist and the canvas.
The destination and thoroughfare.
It illuminates, reflects and obscures.
There is no other thing on earth like it.

Glass is glorious.
Imagine, for a moment, a glassless world.
How different life would be.
No mirror to reflect our sense of self.
No insulating glass to keep us comfortable while allowing a view. No vantage point into cars or out of small spaces.
No security with a vista.

There is no thing on earth like glass.
It is a chameleon to be celebrated.
It changes shape and depth and color to meet the needs of its surroundings.
A delightfully durable material of strength and whimsy.
Give bricks, concrete, wood and metal their due.
But nothing does what glass is. ❖

Our sponsors at Vitro Architectural Glass commissioned this educational brochure to help those who design and build with glass to understand its characteristics and the building codes that affect it. We hope it proves helpful to you as you work with a material that knows no bounds.

Vitro projects, clockwise from left:
VIA 57 West, New York, New York, Solarban® 70XL glass; UCSD Jacobs Medical Center, La Jolla, Calif., Solarban® 70XL glass coated on Starphire Ultra-Clear® glass and Solarban® 72 glass;Chicago O'Hare Airport, Terminal 5, Chicago, Starphire® glass; The Terry Thomas, Seattle, Solarban® 70XL glass; The Tower at PNC Plaza, Pittsburgh, Sungate® 400 passive low-E glass and Starphire-Ultra-Clear® glass.

Codes for the Planet

Green & Energy Regulations

Energy codes set the minimum efficiency requirements for both new and renovated buildings. There are a number of building codes that affect the use of glass and glazing products. The two primary standards that apply to the energy performance requirements for exterior fenestration and glazing systems are ASHRAE 90.1 and the International Energy Conservation Code. In addition, some states have developed their own codes for energy performance, and other organizations have combined efforts to create one stringent "green" code.

ASHRAE 90.1

ASHRAE 90.1, "Energy Standard for Buildings Except Low-Rise Residential Buildings" provides the minimum requirements for energy-efficient design of most buildings, except low-rise residential buildings. There are multiple versions of the standard, which are referenced by different states across the country *(see map below)*.

The most recent version is ASHRAE 90.1—2016 and it is currently being reviewed by the states for consideration based on more stringent requirements. It is important to recognize that the performance requirements for these standards are for the fully framed glazing systems and not just for the center-of-glass performance.

IECC

The second referenced standard is the IECC, which was developed by the International Code Council (ICC). The most recent version was published in 2018. The IECC is in use or adopted in 48 states, the District of Columbia, Puerto Rico and the U.S. Virgin Islands. California's energy codes requirements conform to the 2016 California Title 24 Building Energy Efficiency Standards, and Indiana references the 2010 Indiana Energy Conservation Code based on ASHRAE 90.1-2007.

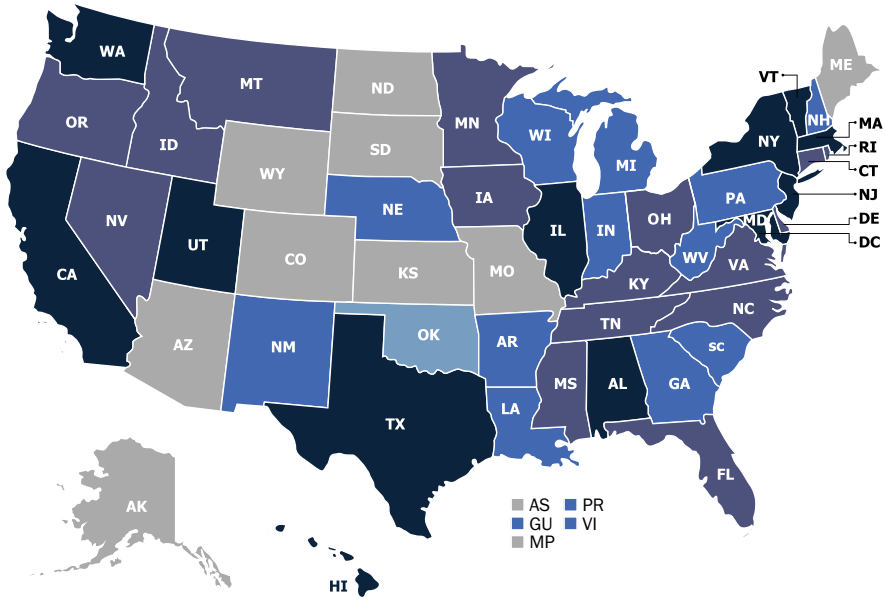
A comparison of the U-factor and Solar Heat Gain Coefficient (SHGC) requirements of the IECC and various versions of ASHRAE 90.1 is illustrated in the chart on the following page.

Title 24

California's Title 24 mandates stringent energy performance requirements. These include lower U-factors based on product type, such as curtainwall and storefront. Other fixed windows and operable windows require low-E double glazing with a thermally broken frame in most cases, as well as argon and warm edge spacers. In addition, triple-silver low-E coatings likely will be necessary given the code's low SHGC and minimum Visible

continued on page 6

Commercial Code Status



- Meets or exceeds ASHRAE 90.1-2013 or equivalent (12)
- Meets or exceeds ASHRAE 90.1-2010 or equivalent (17)
- Meets or exceeds ASHRAE 90.1-2007 or equivalent (15)
- Meets or exceeds ASHRAE 90.1-2004 or equivalent (1)
- No statewide code or predates ASHRAE 90.1-2004 (11)

(Source: bcapcodes.org)

IECC U-Factor and Solar Heat Coefficients

Vertical Fenestration U-Factors									
Climate Zone	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**Specification**
Non-Metal Framing	1.2	0.75	0.65	0.4	0.35	0.35	0.35	0.35	ASHRAE 90.1-2010
	0.5	0.4	0.35	0.35	0.32	0.32	0.32	0.32	ASHRAE 90.1-2013
	0.5	0.37	0.33/0.35	0.31	0.31	0.3	0.28	0.25	ASHRAE 90.1-2016
	Same as metal framing fixed or operable								
IECC 2012-2018									
Metal Framing - Fixed	1.2	0.7	0.6	0.5	0.45	0.45	0.4	0.4	ASHRAE 90.1-2010
	0.57	0.57	0.5	0.42	0.42	0.42	0.38	0.38	ASHRAE 90.1-2013
	0.57	0.54	0.33/0.35	0.31	0.31	0.3	0.28	0.25	ASHRAE 90.1-2016
	0.5	0.5	0.46	0.38	0.38	0.36	0.29	0.29	IECC 2012-2018
Metal Framing - Operable	1.2	0.75	0.65	0.55	0.55	0.55	0.45	0.45	ASHRAE 90.1-2010
	0.65	0.65	0.6	0.5	0.5	0.5	0.4	0.4	ASHRAE 90.1-2013
	0.65	0.65	0.6	0.46	0.46	0.45	0.4	0.35	ASHRAE 90.1-2016
	0.65	0.65	0.6	0.45	0.45	0.43	0.37	0.37	IECC 2012-2018
Metal Framing - Entrance Doors	1.2	1.1	0.9	0.85	0.8	0.8	0.8	0.8	ASHRAE 90.1-2010
	0.65	0.65	0.6	0.5	0.5	0.5	0.4	0.4	ASHRAE 90.1-2013
	1.1	0.83	0.77	0.68	0.68	0.68	0.68	0.68	ASHRAE 90.1-2016
	1.1	0.83	0.77	0.77	0.77	0.77	0.77	0.77	IECC 2012-2018
Vertical Fenestration SHGC									
Climate Zone	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**Specification**
SHGC	0.25	0.25	0.25	0.4	0.4	0.4	0.45	0.45	ASHRAE 90.1-2010 & 2013
									IECC 2012 & 2015
	0.25	0.25	0.25	0.36	0.38	0.4	0.45	0.45	ASHRAE 90.1-2016
Source: IECC									IECC 2018

The chart above compares the differences in U-factor and SHGC requirements of the IECC and various versions of ASHRAE 90.1 for different glazing products.

IgCC ASHRAE U-Factor Requirements

Vertical Fenestration U-Factors									
Climate Zone	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**Specification**
Non-Metal Framing	0.45	0.36	0.32	0.32	0.29	0.29	0.29	0.29	ASHRAE 189.1-2014
	0.48	0.35	0.31	0.29	0.29	0.29	0.27	0.24	ASHRAE 189.1-2017 & 2018 IgCC
									2015 IgCC
	same as metal framing fixed or operable								
Metal Framing - Fixed	0.51	0.51	0.45	0.38	0.38	0.38	0.34	0.34	ASHRAE 189.1-2014
	0.54	0.51	0.43	0.36	0.36	0.36	0.31	0.28	ASHRAE 189.1-2017 & 2018 IgCC
	0.48	0.48	0.44	0.36	0.36	0.34	0.28	0.28	2015 IgCC
Metal Framing - Operable	0.59	0.59	0.54	0.45	0.45	0.45	0.36	0.36	ASHRAE 189.1-2014
	0.63	0.57	0.44	0.44	0.43	0.38	0.33	0.4	ASHRAE 189.1-2017 & 2018 IgCC
	0.62	0.62	0.57	0.43	0.43	0.41	0.35	0.35	2015 IgCC
Metal Framing - Entrance Doors	0.99	0.75	0.69	0.69	0.69	0.69	0.69	0.69	ASHRAE 189.1-2014
	1.05	0.79	0.73	0.65	0.65	0.65	0.65	0.65	ASHRAE 189.1-2017 & 2018 IgCC
Source: IgCC/ASHRAE	1.05	0.79	0.73	0.73	0.73	0.73	0.73	0.73	2015 IgCC

The chart above illustrates maximum U-factor requirements for vertical fenestration for several versions of the ASHRAE and IgCC standards.

continued from page 7

Transmittance (VT) requirements. The requirements also allow area-weighted averaging across the façade, which can be useful when balancing the higher U-factors of certain products, such as vents and awnings, with the lower U-factors of a high-performance curtainwall.

It's not unusual for architects and designers in California to follow the building performance path. By following this path, you do not have to meet each and every individual prescriptive requirement as long as the energy equivalence of the overall building design can be shown.

California Title 24 has statewide maximum requirements for U-factor, SHGC and VT for all non-residential fenestration and glazed systems *(see chart below)*.

California Title 24 – Commercial

2013 and 2016 Title 24			
	Max U-Factor	Max SHGC	Max VT
Curtainwall/ Storefront	0.41	0.26	0.46
Fixed Windows	0.36	0.25	0.42
Operable Windows	0.46	0.22	0.31

IgCC

In addition to the national energy codes, there are also the more stringent "green" codes. Traditionally, there have been three national green standards: ICC's International Green Construction Code (IgCC); ASHRAE 189.1, Design of High Performance Buildings, except Low-Rise Residential Buildings; and the LEED green building program. In 2016, the three governing bodies agreed to merge the requirements of these three standards into one document.

The IgCC was created to provide a whole-systems approach to the design, construction and operation of buildings. The 2015 IgCC is the currently available version of the code; the 2018 version is under development.

These codes call for higher-performing glass and glazing products, with both the U-value *(see chart on page 7)* and the SHGC set slightly beyond the base energy code. In addition, daylighting is also a major focus of the IgCC. These requirements call for minimum top-lighting in large, open areas, such as warehouses, as well as minimum sidelighting in offices, classrooms and other similar facilities. Other areas covered by the green codes include shading and sun-shading, renewable energy, such as building integrated photovoltaics, and sustainable materials.

Energy Code Awareness

Energy codes, like all building codes, can be challenging to understand. Vitro Architectural Glass offers a number of tools and resources to help you select the right glass to meet your project's specific high-performance needs. Visit www.vitroglazings.com to start your search.

Product Assurance: Environmental Product Declarations

Environmental Product declarations (EPD) are voluntary transparent reports created by companies regarding the life-cycle impacts of their products on the environment. Reporting and documentation for product-specific EPDs address energy use and emissions associated with a product's manufacture and packaging, as well as the extraction, transportation and processing of related raw materials.

Vitro Architectural Glass has published third-party-verified, product-specific Type III Environmental Product Declarations (EPDs) for both its flat glass and processed glass products. The product-specific flat glass EPD is valid for all annealed and untreated glass products manufactured by Vitro. The product-specific processed glass EPD is valid for products that undergo secondary treatment, such as the addition of magnetron sputtered vapor deposition coatings, heat-strengthening or fabrication into multi-pane insulating glass units.

Both EPDs are certified by ASTM International as conforming to the requirements of ISO 14025. Life-cycle assessments for flat glass and processed glass products were performed according to ISO 14040, ISO 14044 and EN 15804 following the product category rules for each product type.

"EPDs continue to grow in value as green building certification programs and sustainable design become more mainstream," says Paul W. Bush, Vitro's director of quality and technical services. "Today's architects demand greater transparency and Vitro Glass is committed to meeting their expanded requirements. As part of that commitment, we decided to pursue the publication of product-specific, third-party-verified EPDs and to post them publicly with the goal of making it easier for architects to confirm the information we provide and to include our EPDs in their sustainability and certification documentation."

The EPDs and other information about Vitro Architectural Glass' sustainability efforts are available through the company's website: www.vitroglazings.com. ❖

Introducing the latest evolution in low-e glass.

Architects strive for continuous improvement—in fact, you might say it's in their DNA. Developed with guidance from architects and featuring proprietary technology by Vitro Architectural Glass (formerly PPG Glass), *Solarban*® 90 glass provides the superior solar control performance and optimal occupant comfort architects have always wanted with the aesthetics of clear glass.

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Architectural Glass

Codes That Bind

Structural Regulations

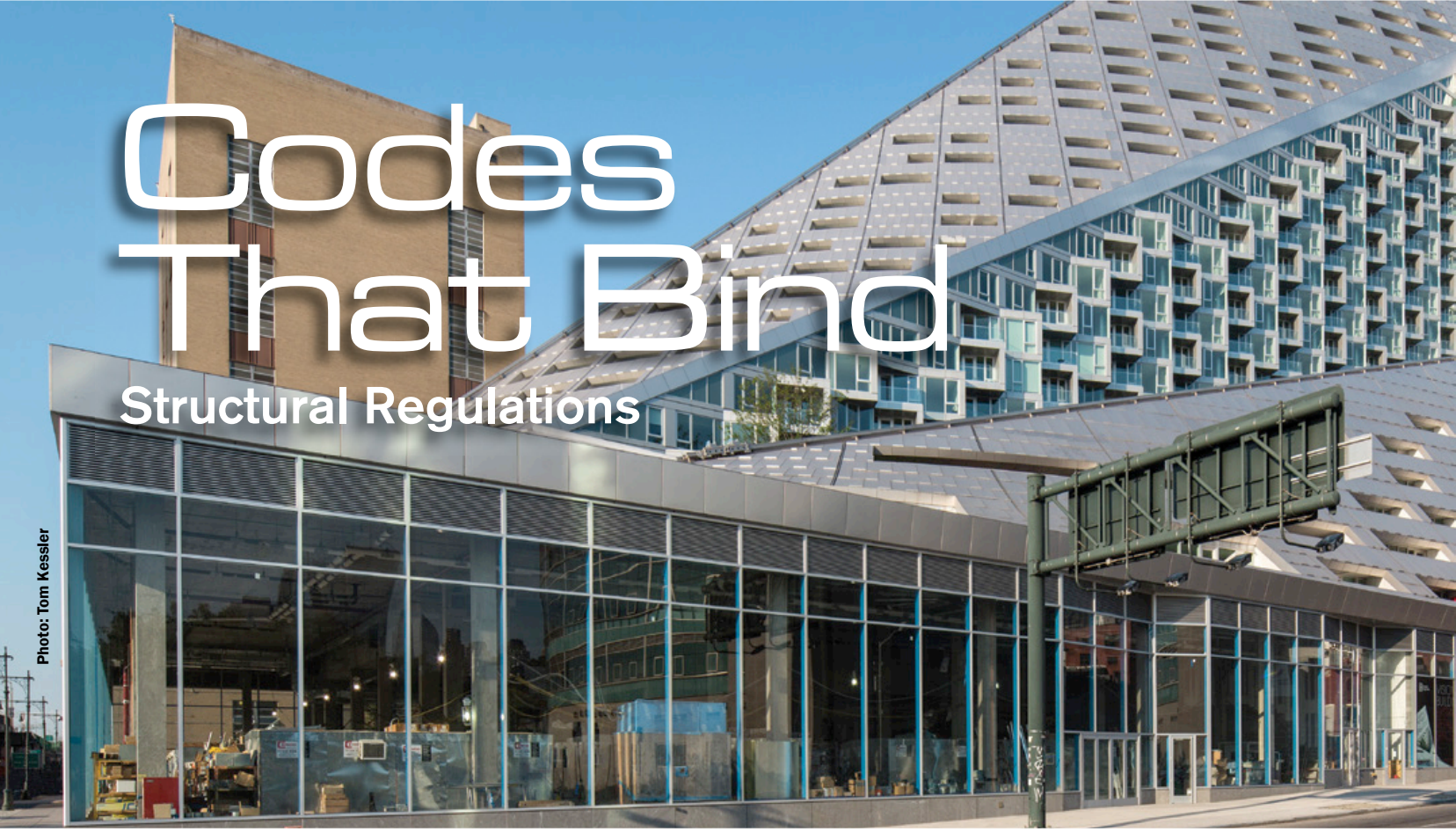

Photo: Tom Kessler

Vitro Architectural Glass products have been used in glazing projects in all regions of the U.S. Examples include VIA 57 West in New York (left), which features Solarban® 70XL glass fabricated by Tecnoglass and installed by

Building codes are written with one goal in mind: safety. Meeting them requires extensive planning, meetings and inspections, and they are critical to the success of any building.

The International Building Code (IBC), developed by the International Code Council (ICC), is in use or adopted in all 50 states, the District of Columbia, the U.S. Virgin Islands, Guam and the Northern Marianas Islands. The most recent version (which at press time was the 2018 IBC) was published in August 2017. However, most jurisdictions lag behind in their adoption of the code, so it is important to continue to reference the 2012 or 2015 versions. The IBC establishes the structural performance requirements for glass, glazing and fenestration installed in all buildings. There are some exceptions, such as detached one- and two-family dwellings and multiple single-family dwellings (i.e., townhouses) not more than three stories above grade plane in height. The requirements for these structures are found in the International Residential Code (IRC).

Here's a closer look at the structural performance requirements of the IBC.[1]

Structural Design

Windloads on buildings are determined in accordance with Chapters 26 to 30 of American Society of Civil Engineers (ASCE) 7 or provisions of the alternate all-heights method in Section 1609.6 of the IBC. In accordance with Section 2404.1,

> *"Glass sloped 15 degrees (0.26 rad) or less from vertical in windows, curtain and window walls, doors and other exterior applications shall be designed to resist the windloads due to ultimate design wind speed, Vult, in Section 1609 for components and cladding. Glass in glazed curtainwalls, glazed storefronts and glazed partitions shall meet the seismic requirements of ASCE 7, Section 13.5.9. The load resistance of glass under uniform load shall be determined in accordance with ASTM E1300."*

Glass Strength

ASTM E1300, *"Standard Practice for Determining Load Resistance of Glass in Buildings,"* describes procedures to determine the load resistance of monolithic and laminated glass, including combinations of glass types used in a sealed insulating glass unit. It does not apply to any form of wired, patterned, sandblasted, drilled, notched, or grooved glass or to glass with surface or edge treatments that reduce the glass strength.

IBC 2015 requirements for framing members that support glass and glazing systems are found in Section 2403.3, "Framing" as follows:

> *"To be considered firmly supported, the framing members for each individual pane of glass shall be designed so the deflection*

1. While the requirements for glazing and fenestration are predominantly the same between the 2012 and 2015 versions of the IBC, these sections reference the 2015 version.

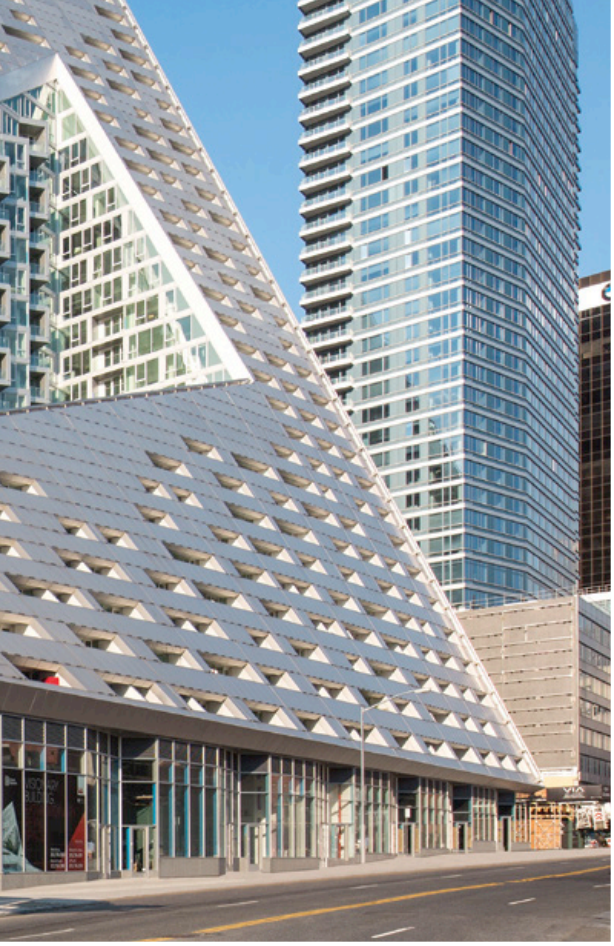

Photo: Tom Kessler

Enclos, as well as the Grove at Grand Bay in Miami, which features Solarban® 72 Starphire® glass, also fabricated by Tecnoglass. Giovanni Monti and Partners was the glazing contractor.

of the edge of the glass perpendicular to the glass pane shall not exceed 1/175 of the glass edge length or 3/4 inch (19.1 mm), whichever is less, when subjected to the larger of the positive or negative load where loads are combined as specified in Section 1605."

The requirements for fully framed exterior windows and doors are found in Section 1709.5:

"Exterior windows and sliding doors shall be tested and labeled as conforming to AAMA/WDMA/CSA101/I.S.2/A440. The label shall state the name of the manufacturer, the approved labeling agency and the product designation as specified in AAMA/WDMA/CSA101/I.S.2/A440. Exterior side-hinged doors shall be tested and labeled as conforming to AAMA/WDMA/CSA101/I.S.2/A440 or comply with Section 1709.5.2. Products tested and labeled as conforming to AAMA/WDMA/CSA101/I.S.2/A440 shall not be subject to the requirements of Sections 2403.2 and 2403.3.

1709.5.2 Exterior windows and door assemblies not provided for in Section 1709.5.1.

Exterior window and door assemblies shall be tested in accordance with ASTM E330. … Exterior window and door assemblies containing glass shall comply with Section 2403. The design pressure for testing shall be calculated in accordance with Chapter 16. Each assembly shall be tested for 10 seconds at a load equal to 1.5 times the design pressure."

Impact Performance

Exterior glazed products installed in windborne debris regions, such as South Florida and certain other coastal regions, are required to be impact-resistant or protected with an impact-resistant covering meeting the requirements of an approved impact-resistant standard or ASTM E1996 and ASTM E1886 as follows. Per the 2015 IBC:

"1. Glazed openings located within 30 feet (9144 mm) of grade shall meet the requirements of the large missile test of ASTM E1996.
2. Glazed openings located more than 30 feet (9144 mm) above grade shall meet the provisions of the small missile test of ASTM E1996."

In accordance with Chapter 2 of the IBC, a wind-borne debris region is defined as:

"Areas within hurricane-prone regions located:

1. Within 1 mile (1.61 km) of the coastal mean high water line where the ultimate design wind speed, Vult, is 130 mph (58 m/s) or greater; or
2. In areas where the ultimate design wind speed is 140 mph (63.6 m/s) or greater."

Tools and Resources

Vitro Architectural Glass offers a number of resources that can help you navigate your code questions related to glass and glazing products. Our team of dedicated experts also can help answer questions and get you on the right track to designing and specifying a structurally sound and safe building. Visit www.vitroglazings.com to learn more. ❖

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Meet the aesthetic demands of architects and the performance demands of owners, all for a modest investment. Developed to withstand value-engineering, new *Acuity*™ Glass by Vitro Architectural Glass (formerly PPG Glass) joins *Starphire* Ultra-Clear® Glass in the Vitro family of low-iron brands. An affordable low-iron option available with *Solarban*® solar control low-e coatings, *Acuity*™ glass offers vivid views with no green cast.

Request samples and learn more at **vitroglazings.com/acuity**

Acuity™
Low-Iron Glass

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Codes for Safety and Health

Safety Regulations

Skyline Design fabricated Starphire® glass for the 1K Fulton project in Chicago. Glass Solutions Inc. was the contract glazier.

Glass is central to most of the building-related codes in the United States, including residential, energy codes and fire codes, among others. The safety glazing codes are chief among these because they are focused on human life safety. Safety glazing codes are designed to preserve the lives of and/or reduce injuries to any individual who comes in contact with glass in a particular opening. Glass is one of the few building materials with some of its use regulated by the Federal government in addition to regulation by code groups. The Code of Federal Regulations, Title 16 Commercial Practices, Chapter II Consumer Product Safety Commission (CPSC), Subchapter B-Consumer Product Safety Act Regulations, includes Title 16, part 1201—Safety Standard for Architectural Glazing.

Federal Regulations

The CPSC regulations detail how to test and certify safety glass products used in architectural applications.

When first put in place in the 1970s, the Federal Code regulated the use of glass in doors and side panels. It did not address most other hazardous locations. That has changed over the years and today 16 CFR 1201 applies only to glass in doors; the International Building Code (IBC) produced by the International Code Council, regulates glass in other locations. It covers glass adjacent to a door or in the same plane as a door, glass in hazardous locations such as pools, spas, certain walking surfaces, shower enclosures, handrails, etc. Let's look at the Federal CPSC regulation first.

It generally requires safety glazing in:

- Storm doors
- Combination doors;

The Right One for Your Project

Photo: Goldray Industries

Goldray applied a digitally printed pattern to Starphire® glass used in Terminal 5 at the Chicago O'Hare Airport.

So for strength and breakage-resistance, tempered glass is often the first consideration. For flexibility, UV-resistance, security and sound considerations, laminated glass is often the product of choice. Both are considered safety glazing materials and can be obtained in a variety of thicknesses and colors or tints. Both are easy to clean and maintain when installed properly.

Typically, laminated glass products are slightly more expensive than tempered products of the same type and thickness. The optical clarity for both laminated and tempered glass is excellent, and either product will provide many years of satisfactory service in your application.

Photo: Scott Shigley

- Doors;
- Bathtub doors and enclosures;
- Shower doors and enclosures;
- Sliding doors, such as the patio type.

It has exemptions for:

- Louvers of jalousie doors;
- Certain wired glass applications;
- Carved, dalle or leaded glass if the glazing meets certain criteria.

State and National Building Codes

Local and national building codes such as the IBC address glazing in hazardous locations.

Hazardous locations include:

- Doors (though the language about doors is harmonized with the language in 16 CFR 1201);
- Glazing adjacent to doors;
- Windows;
- Glazing in guardrails and railings;
- Glazing near wet surfaces;
- Glazing next to stairways and ramps or next to a stairway landing.

The IBC also covers glass in a variety of applications. Specifically:

- Chapter 24—Glass and Glazing 2405—Sloped Glazing and Skylights
- 2406—Safety Glazing
- 2407—Glass in Handrails and Guards
- 2408—Glazing in Athletic Facilities
- 2409—Glass in Walkways and Elevators.

In rare cases, states and larger municipalities adopt their own glazing codes or modify those provided by the ICC.

What is Safety Glass?

CPSC uses the testing procedures detailed in ANSI Z97.1-2015, *the American National Standard for Safety Glazing Materials in Buildings-Safety Performance Specifications and Methods of Test* to determine whether a particular glass is considered safety glazing or not.

ANSI Z97.1-2015 is a voluntary standard that codifies both performance specifications and testing methods for safety glazing. It also has two categories. CPSC Cat I glass is generally equivalent to ANSI Class B; CPSC Cat II is generally equivalent to ANSI Class A. Either terminology is acceptable.

The CPSC's Safety Standard defines two different types of safety glass—simply named Category I and Category II for their reference in the regulations. CPSC 16 CFR 1201-1 (Cat 1) defines safety glass as glass that is subject to human impact but has an area of less than or equal to 9 square feet. CPSC 16 CFR1201 -2 (Cat 2) defines glass used in any area greater than 9 square inches.

Which Glasses are Safety Glasses?

When selecting safety glass for an application, whether decorative or functional, two choices often arise: tempered or laminated glass. Both qualify as "safety glazing materials" meaning they comply with the current safety glazing codes, so they can be used in doors, in sidelites, railings and other locations that may be deemed hazardous.

Tempered (Toughened) Glass

Tempered glass is made by heating and cooling a piece of standard glass in a tempering furnace. The glass, which must be pre-cut and edged before going into the furnace, is heated to approximately 1200°F then cooled rapidly.

This process is also known as quenching. The quenching process leaves the glass hardened so that it is now approximately four to five times stronger, and therefore more resistant to breakage than it was before the tempering process. If it does break, tempered glass shatters into small pieces that are less likely to cause injury or damage than non-tempered glass.

Pros and Cons of Laminated Glass

Laminated glass basically is a glass sandwich. It is typically made of two or more lites of glass with a vinyl interlayer in between (sandwiched, if you will, as in a car's windshield). The glass will tend to stay together in case one lite is broken.

The other key advantages of laminated glass is that it blocks 99 percent of the UV-light transmission, has sound reduction properties, can be cut and its edges polished after laminating, and lead times are generally faster because most glass shops stock laminated glass. Certain thicker, multilayered forms of laminated glass can even qualify as burglar- and bullet-resistant glass.

Because laminated glass holds together after impact better than most other types of glass, it is used in modern windshields. The sandwiched interlayer gives the glass structural integrity and keeps it from shattering apart as tempered glass might. This is key for effective airbag deployment and helping to keep occupants inside the vehicle in the event of a crash. ❖

Codes for Birds and Marine Life

Nature's Regulations

Glazing products that can "go green" extend beyond those that can help increase the energy efficiency and performance requirements of buildings. Glazing products also can be beneficial in mitigating the potentially harmful impact to the surrounding environment, including wildlife.

Photo: Phillip Castleton Photography

BioSteel Centre in Toronto features AviProTek® bird-friendly glass by Walker Textures® glass, acid-etched on tinted Optiblue® glass and Solarban® R100 glass. Trulite was the glass fabricator.

Turtle Codes

Coastal areas are prime locations for the use of large spans of glass. Lighting from inside homes and buildings onto shorelines, however, is an important design consideration, as it can be detrimental to nearby sea turtles.

The sea turtle nesting season in Florida runs from May through October. After hatchlings emerge, they head toward the light over the ocean, but, in many cases they are disoriented by the light inside homes and buildings along the beach and head the wrong way. This can be a danger to the hatchlings, which can die or be killed before finding their way to the ocean.

Because sea turtles are protected by the Federal Endangered Species Act of 1973, Florida Endangered and Threatened Species Act of 1977, and Florida's Marine Turtle Protection Act of 1995 (379.2431), the state of Florida developed a Model Lighting Ordinance for Marine Turtle Protection. This prohibits light from having a negative effect on nesting and hatching turtles. The ordinance requires that tinted glass be used on all windows and doors in new construction of single or multi-story structures within line-of-sight of the beach.

Tinted glass, according to the ordinance, refers to "glass treated to achieve an industry-approved, inside-to-outside light transmittance value of 45 percent or less. Such transmittance is limited to the visible spectrum (400 to 700 nanometers) and is measured as the percentage of light that is transmitted through the glass."

Vitro Architectural Glass offers a number of products that can be used to meet these requirements. Combining a tinted substrate with one of the low-E coatings from Vitro Architectural Glass in an insulating glass unit (IGU), for example, creates many options that provide a visible light transmittance (VLT) of 45 percent or less.

For existing buildings, the ordinance lays out a number of measures to reduce or eliminate the negative effects of interior light coming from doors and windows within line-of-sight of the beach. These actions include updating windows to meet the 45 percent light transmittance requirements, applying tint or film that meets these same standards, and using window treatments, among other actions.

The 45 percent or less VLT is also beneficial in reducing glare and solar heat gain. Hurricane-rated glass also can be constructed to meet these requirements.

Bird-Friendly Glass

Each year, more than 600 million birds die from collisions with glass in the United States alone. Although bird-friendly building regulations continue to increase in North America, glazing options have been limited.

Vitro Architectural Glass and Walker Glass have partnered to create

AviProtek®E glass: a line of sustainable glass options that deliver both exceptional energy efficiency and bird safety, with minimal impact on VLT.

Experts agree that the best way to deter birds from striking glass is through visual markers on the #1 or outside surface of the glass. By combining a Walker AviProtek® acid-etched pattern on surface #1 with a Solarban® high-performance low-E coated glass by Vitro on surface #2 in an IGU, architects and building owners get an environmentally responsible glass that does double duty.

AviProtek® E glass is available in standard or custom patterns on clear or Starphire Ultra-Clear® glass by Vitro Glass, combined with Solarban® 60, Solarban® 67 or Solarban® 70XL solar control low-E glass coatings, exclusively from members of the Vitro Certified™ Network.

Bird Safe Glazing Standards and Guidelines

Published Standards or Guidelines:

- Toronto, Canada, Bird-Friendly Development Guidelines (2007)
- San Francisco, Standards for Bird-safe Buildings (2011)
- State of Minnesota, Sustainable Building 2030 (SB 2030); Energy Standards (2010)
- Cook County, Ill., Building Construction Ordinance (2008)
- Oakland, Calif., Bird Safety Measures (2013)
- Portland, Ore., Resource Guide for Bird-friendly Building Design (2012)
- State of California, Green Building Standards Code, Appendix C: Bird-friendly Building Design (2010)
- Calgary, Canada, Bird-Friendly Urban Design Guidelines (2011)
- San Jose, Calif., Bird Friendly Guidelines (2015)
- Vancouver, Canada, Bird Strategy and Bird-Friendly Design Guidelines and Bird-Friendly Landscape Operational Guidelines (2015)

Proposed or Pending Standards or Guidelines:

- Federal Bird-Safe Buildings Act of 2011
- State of New York, Bird-friendly Buildings Act (2011)
- Sunnyvale, Calif., Bird Friendly Guidelines (2015)

Bird-Friendly Glass Checklist

Not sure what to look for in bird-friendly glazing? These guidelines can serve as a starting point to help address and manage bird-window collisions. This checklist provides guidance on treatments and techniques for both new and retrofit construction.

At Grade Conditions:

The bird-friendly treatment should be applied to at least 85 percent of the contiguous glass panel area if each panel area is greater than two square meters and within 16 meters from the finished grade.

Roof Landscape Conditions:

The bird-friendly treatment should be applied to at least 85 percent of the contiguous glass panel area if each panel area is greater than two square meters and within 16 meters from the roof-level finished grade; the development should not contain any glass panel within 16 meters from the roof-level finished grade.

Patterns (one or more should apply):

- **Stripes**: Horizontal strips are spaced less than 5 cm on center; vertical strip spacing is less than 10 cm on center; horizontal strip widths should be greater than 3.1mm; and vertical strip widths should be greater than 6.1mm.
- **Dots**: The dot size is larger than 5 mm; horizontal strip spacing is less than 5 cm on center; and vertical strip spacing is less than 10 cm on center.
- **Specifications**: The pattern should be applied as fritting or etching on the glass; and the pattern color should be a high contrast in relation to the background. ❖

The bird-friendly glass in the Humber College Centre for Entrepreneurship in Toronto was fabricated by Trulite. The project incorporates AviProTek® bird-friendly glass by Walker Textures® glass, acid-etched on tinted Solarban® 70XL glass.

Fire-Rated Glazing Codes

More Safety Regulations

At first glance, fire-rated glass might not seem all that different than traditional glass products. Yet fire-rated glazing is very different in not only its composition, but also in how and where it can be used in building projects. Fire-rated glass is a life safety product, and its use is governed by the International Building Code (IBC). While regular glass breaks easily during a fire, fire-rated glass products are designed to stay in the opening, keeping smoke and flames away.

Photo: SAFTI FIRST

Fire-rated glass products can be used in a variety of applications, including building exteriors, such as The Kensington, located in Boston.

A Closer Look

There are two types of fire-rated glass: fire-protective glass and fire-resistive glass. Fire-protective glass includes ceramics, specialty fire protective glass, and wired glass. It is tested to National Fire Protection Association (NFPA) 252/257 or Underwriters Laboratories (UL) 9/10B/10C and is designed to compartmentalize smoke and flames. It does not radiate heat, and therefore is subject to application, area and size limitations under the IBC. Fire-protective glass typically is used in doors and openings up to 45 minutes *(see box on page 19)* and cannot exceed 25 percent of the total wall area. It can be used in 60- and 90-minute doors, but is limited to 100 square inches. Fire-protective glass is marked with either a D for door or O for openings. If it meets the hose stream test *(see box on left)* it will be marked with an H.

Fire-resistive glass is tested to American Society for Testing and Materials (ASTM) E-119/UL 263 and is designed to compartmentalize smoke and flames and limit radiant heat transmission. Unlike fire-protective glass, fire-resistive glass doesn't have size or application restrictions. When installed within an equally rated fire-resistive framing system, it can be used in wall-to-wall and floor-to-ceiling applications, and is considered a "transparent wall." This type

What is the Hose Stream Test?

The hose stream involves heating the glazing product in a furnace to more than 1600° F for 45 minutes, and even higher temperatures for longer ratings. Immediately after heating, the hot glass is sprayed with water from a fire hose at specified pressures. If the glass remains intact without exceeding the tolerable openings, it passes the test. The NFPA 257 hose stream test allows for a 30 percent loss of glazing around the perimeter and a 5 percent loss at the center.

NFPA 251, ICC model codes and ASTM E-119 exclude fire-rated construction of less than one hour from the hose stream test requirement; 45-minute glazing, which is limited to no more than 25 percent of the total wall area, must pass the hose stream test. Twenty-minute glazing products are exempt.

Passing the Test

Fire-rated glazing products are required to undergo a fire-endurance rating test, which is conducted in a nationally recognized testing laboratory. During the test, the fire-rated glass is placed in a test furnace where it follows a specific time and temperature curve that mimics the normal progression of a fire. Temperatures in the furnace can reach up to 1900° F. If the specimen remains in the frame with no through openings and limits flames, it is certified with a fire-endurance rating of either 20, 45, 60, 90, or 120 minutes, depending on what it passes.

of glass is marked with a W for walls. Because the code recognizes it as a wall, it can be used in place of gypsum or masonry where a one- or two-hour fire-resistive rating is required. It also can be used in glass floor applications as fire barriers and fire-resistance-rated horizontal assemblies. Examples include fire-resistive tempered and multi-laminates. During a fire, the intumescent interlayers expand and react to the heat, forming a solid wall that contains smoke, flames and limits the transmission of radiant heat significantly. This helps provide building occupants a safe path of egress.

Codes to Know

International Building Code (IBC), Chapter 7, Fire-Resistance Rated Construction

Per the IBC, this chapter governs "the materials and assemblies used for structural fire resistance and fire-resistance-rated construction separation of adjacent spaces to safeguard against the spread of fire and smoke within a building and the spread of fire to or from buildings."

NFPA 252: Standard Methods of Fire Tests of Door Assemblies

This standard outlines methods of fire-testing door assemblies used by testing labs and manufacturers to determine the assembly's degree of fire protection, as well as it suitability when fire resistance of a specific duration is required.

NFPA 257: Standard on Fire Test for Window and Glass Block Assemblies

This document establishes test protocols to measure how well window and glass block assemblies prevent or slow the spread of fire. It provides a standardized method for comparing the relative performance of different fire window assemblies.

UL 9, Standard for Fire Tests of Window Assemblies

These fire test methods apply to window assemblies for use in the protection of openings in vertical fire-resistive assemblies.

UL 10B, Standard for Fire Tests of Door Assemblies

These fire test methods apply to door assemblies of various materials and types of construction for use in wall openings to delay the passage of fire.

UL 10C, Standard for Positive Pressure Fire Tests of Door Assemblies

These fire test methods apply to swinging door assemblies, including door frames with lites and panels, of various materials and types of construction for use in wall openings to delay the passage of fire. Swinging door assemblies, when not part of a larger assembly (such as a sliding fire door), or when used as an elevator entrance, are not included.

UL 263, Standard for Fire Tests of Building Construction and Materials

These fire tests apply to masonry unit assemblies and to composite assemblies of structural materials for buildings, including bearing and other walls and partitions, columns, girders, beams, slabs, and composite slab and beam assemblies for floors and roofs. They also apply to assemblies and structural units that constitute permanent integral parts of a finished building.

ASTM E-119, Standard Test Methods for Fire Tests of Building Construction and Materials

These test methods apply to assemblies of masonry units and to composite assemblies of structural materials for buildings, including load-bearing and other walls and partitions, columns, girders, beams, slabs and composite slab and beam assemblies for floors and roofs. They also apply to other assemblies and structural units that constitute permanent integral parts of a finished building. The test methods evaluate the duration for which these building elements contain a fire, retain their structural integrity or exhibit both properties during a predetermined test exposure. ❖

Glass Education

Photo: Tom Kessler

The Nemours/Alfred I. duPont Hospital for Children in Wilmington, Del., features Solarban® 60 Azuria® and Solarban® 70XL glasses fabricated by Cristacurva and Oldcastle BuildingEnvelope® and installed by RA Kennedy.

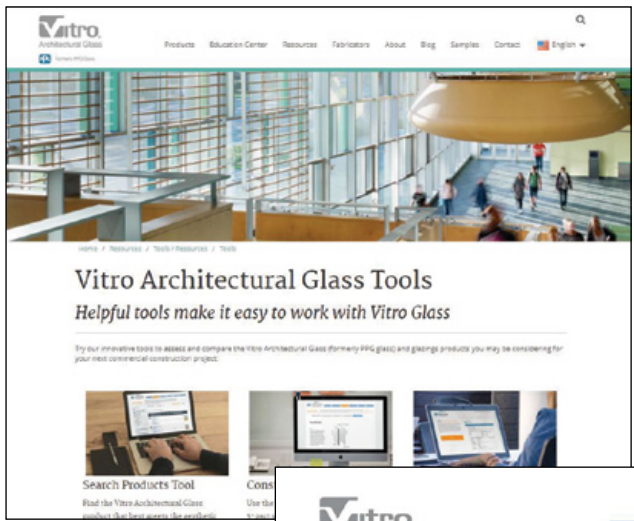
Glass is one of the most sought-after building materials in today's architectural market, and for good reason. Not only is it aesthetically pleasing, but it also provides plenty of high-performance features and benefits. With so many product options available—and hundreds of building code requirements driving what to use when and where—it's common to have questions. To help architects navigate their glass and glazing product selections, Vitro Architectural Glass has developed a series of online tools to make design and specification easy for your next project.

Start by taking a look at the online Vitro Glass Education Center, a comprehensive website to help architects, specifiers, students and construction industry professionals learn more about designing, specifying and building with glass. It is divided into three sections; Glass Topics, Glass FAQs and a Glossary and includes a comprehensive mix of informative videos, colorful illustrations and educational features that address issues such as preventing thermal glass breakage, specifying large insulating glass units (IGUs), how low-emissivity (low-E) glass works, and how heat-treated glass differs from heat-strengthened glass.

By hovering over the Glass Topics section, visitors will see numerous articles such as "How Glass is Made," "The Benefits of Designing with Reflective Glass," and "How to Prevent a Thermal Break."

These topics and many more are all important when researching a new project. There is also an article titled "Why Specify Which Type of Glass?" and a slide show that highlights the different types of glass, and what is appropriate to use in various architectural situations.

The Vitro Glass Education Center



Vitro offers a number of online educational resources to help architects and specifiers find the right glass products for their projects.

Spec Check

One unique feature of the Education Center is the Spec Check tool, a helpful resource for checking glass specification. Correct specifications are extremely important to ensure projects are designed correctly and that the proper codes and standards are followed. The Spec Check can be used on every project, to make sure products that meet specifications are chosen correctly.

Architectural Glass Tools

Another resource available from Vitro is its online Architectural Glass Tools. This unique feature offers four tools to help architects select the right glass for their projects, including the Search Products Tool, Construct Tool, Thermal Stress Analysis Tool and more. These tools allow architects to compare and assess different products, while learning more about Vitro's many glass options.

Construct Tool

With the Construct Tool from Vitro Architectural Glass, users can quickly generate 3-part specifications in the Construction Specifiers Institute (CSI) format, the basis for all building construction documentation in North America.

The tool allows users to search, construct and compare virtual configurations for monolithic glazings, multi-pane insulating glass units, decorative glasses and spandrel glasses. With the new feature, they can generate, with a single keystroke or mouse-click, industry-standard 3-part CSI specifications for any such configuration they create using the Construct Tool, as long as it contains 100-percent Vitro Glass products.

"Our Construct Tool is widely used because it enables architects and industry professionals to save time by comparing multiple glazing configurations online for performance and aesthetics," says Steve Marino, technical support manager, Vitro Architectural Glass. "The new feature makes the Construct tool even more versatile and valuable by instantly generating required construction documents for those configurations as well."

The 3-part CSI specification lists performance data for individual glazing configurations such as glass thickness, visible light transmittance, interior and exterior reflectance, winter nighttime u-value, solar heat gain coefficient and light-to-solar gain ratio. It also contains descriptions for the glass products used in the glazing configuration, along with related certification standards, testing and compliance requirements, sourcing information and more.

The Construct tool incorporates several other exclusive features including:

- Password-free access to the Lawrence Berkeley National Laboratory International Glazing Database for use with the WINDOW 7.3 software; and
- The ability to customize reports according to user-defined criteria, and to personalize them with the name of a building project, the logo of the architectural firm and other user-provided artwork.

www.vitroglazings.com

Information

American Architectural Manufacturers Association (AAMA) ..... www.aamanet.org

American Bird Conservancy (Bird-friendly codes) ..... www.abcbirds.org

American National Standards Institute (ANSI) ..... www.ansi.org

American Society of Civil Engineers (ASCE) ..... www.asce.org

American Society of Heating Refrigerating and Air-Conditioning Engineers (ASHRAE) ..... www.ashrae.org

American Society of Testing Materials (ASTM) ..... www.astm.org

ANSI Z97.1 Safety Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test. www.ansiz97.com/standard/

Consumer Product Safety Commission (CPSC) ..... www.cpsc.gov

Canadian Standards Association (CSA) ..... www.csagroup.org

Florida Administrative Codes and Administrative Register (Turtle-Friendly Codes) ..... https://www.flrules.org/gateway/ChapterHome.asp?Chapter=62b-55

Ask the Glass Detective, Glass.com® ..... www.glass.com

International Code Council (ICC) ..... www.iccsafe.org

Insulating Glass Certification Council (IGCC) ..... www.igcc.org

Insulating Glass Manufacturers Alliance (IGMA) ..... www.igmaonline.org

International Standards Organization (ISO) ..... www.iso.org

Leadership in Energy & Environmental Design (LEED) ..... www.leed.usgbc.org

National Fire Protection Association (NFPA) ..... www.nfpa.org

National Fenestration Rating Council (NFRC) ..... www.nfrc.org

Safety Glazing Certification Council (SGCC) ..... www.sgcc.org

Underwriters Laboratories (UL) ..... www.ul.com

Vitro Glass Education Center ..... www.vitroglazings.com

Window & Door Manufacturers Association (WDMA) ..... www.wdma.com

Photo: Jim Scafer

The Phipps Conservatory and Botanical Gardens, Center for Sustainable Landscaping in Pittsburgh features Vitro Architectural Glass Products.

NOTE: The publisher does not provide design, code, material or engineering advice. This material has been prepared for informational purposes only, and is not intended to provide, and should not be relied on for design, code, engineering or any other advice. You should consult your own advisors before engaging in any project.

Humber College Centre for Entrepreneurship in Toronto incorporates AviProTek® bird-friendly glass by Walker Textures® glass, acid-etched on tinted Solarban® 70XL glass.

Resources:

ANSI
1899 L Street, NW, 11th Floor
Washington, DC 20036

ANSI z 97.1
http://www.ansiz97.com/standard/

ASTM
100 Barr Harbor Drive
P.O. Box C700
West Conshohocken, PA 19428-2959

Florida Administrative Code & Florida Administrative Register, Model Lighting Ordinance for Marine Turtle Protection
https://www.flrules.org/gateway/ChapterHome.asp?Chapter=62b-55

Glass.com
20 P G A Dr., Suite 201
Stafford, VA 22554

U.S. Consumer Product Safety Commission
U.S. Code of Federal Regulations, Title 16 Volume 2, Consumer Product Safety Commission 16 CFR 1201
4330 East West Hwy.
Bethesda, MD 20814

Common Acronyms

Abbreviation	Full Name	Website
AAMA	American Architectural Manufacturers Association	www.aamanet.org
ANSI	American National Standards Institute	www.ansi.org
ASCE	American Society of Civil Engineers	www.asce.org
ASHRAE	American Society of Heating Refrigerating and Air-Conditioning Engineers	www.ashrae.org
ASTM	American Society of Testing Materials	www.astm.org
CPSC	Consumer Product Safety Commission	www.cpsc.gov
CSA Group	Canadian Standards Association	www.csagroup.org
ICC	International Code Council	www.iccsafe.org
IGCC	Insulating Glass Certification Council	www.igcc.org
ISO	International Standards Organization	www.iso.org
LEED	Leadership in Energy & Environmental Design	www.leed.usgbc.org
NFPA	National Fire Protection Association	www.nfpa.org
NFRC	National Fenestration Rating Council	www.nfrc.org
SGCC	Safety Glazing Certification Council	www.sgcc.org
UL	Underwriters Laboratories	www.ul.com
WDMA	Window & Door Manufacturers Association	www.wdma.com

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