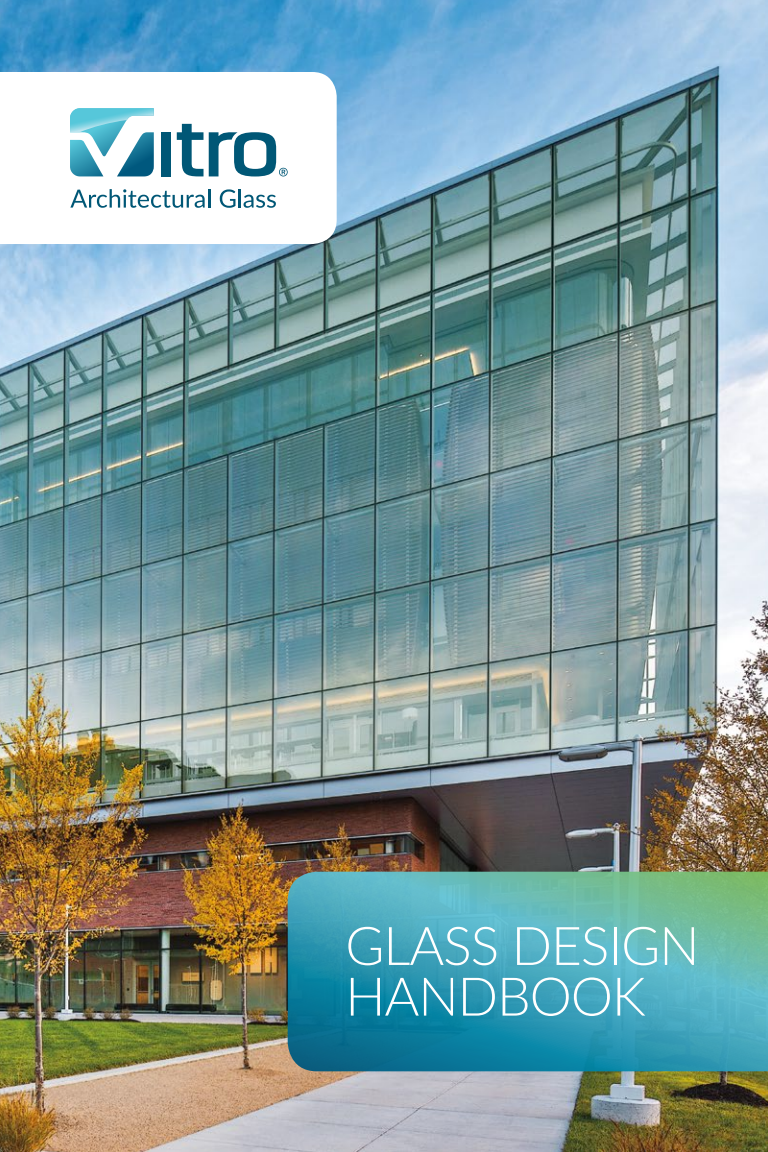

Vitro
Architectural Glass
GLASS DESIGN
HANDBOOK

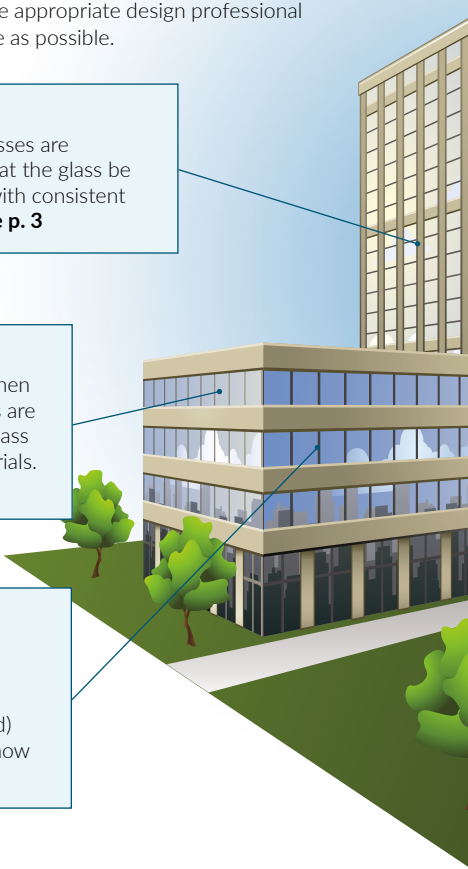
Top Considerations for Glass Selection & Specification

In addition to the important considerations of aesthetics and energy related performance characteristics of glass products, it is critical that attention be given to other design considerations. This should be done by the appropriate design professional as early in the design cycle as possible.

Surface Orientation
When darker tinted glasses are specified, it is critical that the glass be fabricated and glazed with consistent surface orientation. **See p. 3**

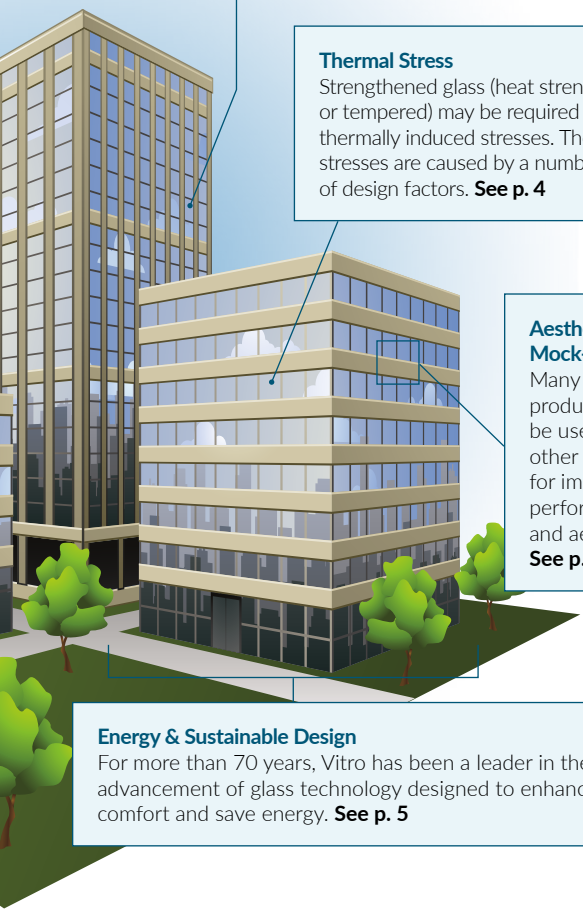
Color Shift
Color shift can occur when some coatings and tints are incorporated into the glass design with other materials. **See p. 4**

Wind & Snow Loads
Specify the appropriate glass thickness and type (annealed, heat strengthened, tempered) to resist wind and/or snow loads. **See p. 3**



Safety
Appropriate safety glazing materials, such as tempered or laminated glass, must be specified where required by code or application. **See p. 3**

Thermal Stress
Strengthened glass (heat strengthened or tempered) may be required to resist thermally induced stresses. These stresses are caused by a number of design factors. **See p. 4**



Aesthetics & Mock-Up
Many glass products can be used with other materials for improved performance and aesthetics. **See p. 6**

Energy & Sustainable Design
For more than 70 years, Vitro has been a leader in the advancement of glass technology designed to enhance comfort and save energy. **See p. 5**

Acclaimed Applications

Some of the world's most sustainable buildings utilize low-e glass products by Vitro, including 24 AIA Committee on the Environment (COTE) winners since 2008, three Certified Living Buildings, six Net Zero Energy Certified Projects and dozens of LEED® Platinum buildings.

A. Bullitt Center
2015 AIA Committee on the Environment (COTE) Top Ten Green Buildings

B. David L. Lawrence Convention Center
LEED® Platinum Certified

C. The Tower at PNC Plaza
LEED® Platinum Certified

Vitro Architectural Glass: A Culture of Sustainability

Environmentally Progressive Products

High-performance low-e coated glasses and ecologically friendly solutions from Vitro help reduce energy costs and support environmental responsibility, including:

- ***Solarban®*** solar control family of low-e glasses
- ***Starphire®*** and ***Acuity®*** low-iron glasses
- ***Sungate®*** passive low-e glasses

Sustainability Documentation

Throughout its history, Vitro Architectural Glass has raised the bar by becoming the first glass manufacturer in the worldwide and North American markets to certify critical sustainability documentation—such as **Environmental Product Declarations** and ***Cradle to Cradle™*** Certification—for its entire collection of architectural glasses. Get sustainability documentation and more at **vitroglazings.com/sustainability**.

LEED® Support

Get guidance on earning LEED® credits through glass selections with the Vitro Glass Guide to LEED® at **vitroglazings.com/leed**.

Contact us at
archservices@vitro.com
1.855.VTRO.GLS (1.855.887.6457)

Glass Design Guidelines

In addition to specifying glass for its aesthetic and energy related performance, specifiers and design professionals must consider and account for several factors as early as possible in the design/specification process.

Safety

Appropriate safety glazing materials, such as tempered or laminated glass, must be specified where required by code or when dictated by design judgment based on the intended application.

Wind & Snow Loads

The appropriate glass thickness and type (annealed, heat strengthened or tempered) must be specified to withstand the design wind and/or snow loads for the application. The current industry-accepted procedure for determining the load resistance of glass is **ASTM E1300: "Standard Design Practice for Determining Load Resistance of Glass in Buildings."** Review Vitro Technical Document **TD-134: "Designing Glass to Resist Wind and Snow Loads,"** in the Technical Bulletins section of the Vitro Architectural Glass website, for a brief tutorial on the use of ASTM E1300. A computerized version of the ASTM E1300 procedure also is available for purchase from the Standards Design Group, Inc. (StandardsDesign.com). A computerized version of ASTM E1300 is available on the Vitro website for *Vitro Certified*™ Network customers.

Surface Orientation

When darker-tinted glasses are specified, the glass must be fabricated and glazed with consistent surface orientation to achieve a unified appearance. For more information, review Vitro Technical Document **TD-122: "Surface Orientation of Low Light Transmittance Glasses,"** in the Technical Bulletins section of the Vitro website.

Thermal Stress

Strengthened glass (heat strengthened or tempered) may be required to withstand thermally induced stresses in specified applications. Such stresses are caused by a number of design factors, including glass type, shading patterns, indoor shading devices and others, which can and do lead to glass breakage if not properly accounted for during the specification process.

Thermally induced glass breakage is recognized and well understood in the glass industry. Vitro provides procedures to help design professionals evaluate such risks and specify strengthened glass, when required.

Additional information is available in Vitro's Technical Document **TD-109: "Thermal Stress Update."** Vitro also offers a computerized thermal stress analysis program. Both are available at **vitroglazings.com**.

Color Shift

Responsible design professionals must consider how the combination of materials in an insulating glass unit (IGU) will impact the transmitted and reflective color of the glass, as well as its transmitted and reflective clarity. A transmitted and reflective color shift may result when various coatings and tints are incorporated into the glass design, such as a low-e coating, opacifier coating, tinted interlayer material or other design alternatives. It also is likely that a coating used in an IGU will look different than that same coating used in a laminated construction. Combining standard clear glass with light colored opacifier coatings or interlayers will make such appearance disparities especially evident.

To achieve color consistency, Vitro recommends maintaining consistent glass product constructions throughout a project, viewing a full-size mock-up at the job site and retaining it as a basis for acceptable product.

Energy & Sustainable Design

Since introducing the world's first energy-efficient glass more than 70 years ago, Vitro has been a global leader in advancing glass technology to enhance comfort and save energy. *Solarban*® and *Sungate*® low-e glasses by Vitro Glass, along with the Vitro line of spectrally selective tints, can significantly lower energy costs and associated carbon emissions, as well as initial HVAC capital equipment costs.

As the first U.S. glass manufacturer to recieve *Cradle to Cradle™* Certification for its entire product line, Vitro has demonstrated a commitment to environmentally responsible, sustainable design that is unique to the glass industry. *Cradle to Cradle™* Certification signifies a commitment to designing and manufacturing products that not only enhance energy efficiency, but also limit a product's total impact on the environment—from raw material acquisition, through manufacturing and the building lifecycle, to final recycling and/or disposal.

Aesthetics & Mock-Up

Vitro offers a broad selection of glass products such as clear, ultra-clear and tinted glasses that can be used as standalone products for their own inherent beauty and performance, or combined in IGUs to create deeper and richer hues and improved performance. Many additional aesthetic, environmentally friendly and energy-control solutions can be achieved by including a Vitro high-performance glass coating in a building design, such as a visibly reflective coating or one of Vitro's many non-reflective, solar control low-e coatings.

The ultimate glass solution for any project marries the desired aesthetic to enhance the building façade with design considerations related to performance, safety, wind/snow loads, thermal stress and other design considerations.

Once all design considerations have been appropriately addressed, Vitro strongly recommends the viewing of a full-size mock-up, preferably at the job site, prior to making final design decisions.

Inclusion of Materials in IGU Airspaces

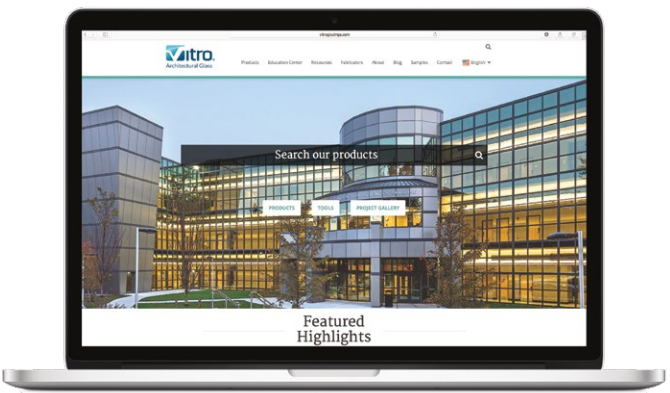
Any material to be utilized inside a hermetically sealed airspace, such as grids (muntins), clips, films, blinds, paints and other coatings, must be tested and approved for such use by that material manufacturer. The compatibility of the material with sealants, as well as the potential release of volatiles into the airspace, must be verified. The inclusion of materials in IGU airspaces raises several concerns, including the following:

- The materials may outgas volatiles that then condense on the glass and/or coated glass surface within the gas space. In addition to causing aesthetic issues, the volatiles may cause coating degradation. Coating degradation or color change caused by volatiles will void any applicable warranty.
- Damage to the low-emissivity (low-e) coating will likely result should any physical contact occur between a material located inside the airspace of the IGU and the low-e coating.
- Materials located inside the airspace of an IGU often have a negative impact on the thermal performance of the IGU by reducing its insulating value.
- Materials that may have an impact on localized glass temperatures have the potential to increase glass breakage due to thermal stress. In addition, while uniform elevated temperatures may not have an immediate effect, they can reduce the overall durability/longevity of the hermetic seal.

Inclusion of Materials in IGU Airspaces (continued)

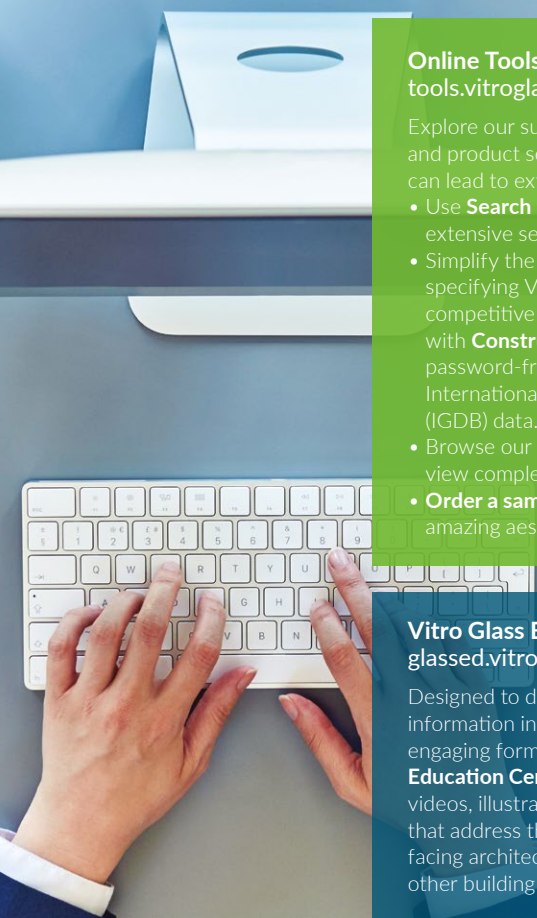
Accordingly, Vitro strongly recommends that careful consideration be given to these issues prior to incorporating materials inside the hermetically sealed airspace. The burden of proof regarding compatibility or fitness for use of any material lies with the manufacturer of that material.

For additional technical information about architectural glass issues, applications and usage guidelines, please visit **vitroglazings.com** and review the Vitro Architectural Glass Technical Bulletins found in the Technical Information section.



Glass Design Resources

Vitro Architectural Glass (formerly PPG Glass) offers two of the industry's most comprehensive portals for glass research, product selection and specification.



Online Tools
tools.vitroglazings.com

Explore our suite of specification and product selection tools that can lead to extraordinary projects.

- Use **Search** to explore Vitro's extensive selection of products.
- Simplify the process of specifying Vitro and even competitive glass products with **Construct**—now featuring password-free access to International Glazing Database (IGDB) data.
- Browse our **Project Gallery** to view completed projects.
- **Order a sample** to see the amazing aesthetics for yourself.

Vitro Glass Education Center
glassed.vitroglazings.com

Designed to deliver technical information in an accessible, engaging format, the **Vitro Glass Education Center** features short videos, illustrations and articles that address the key challenges facing architects, specifiers and other building professionals today.

Vitro
Architectural Glass

vitroglazings.com
tools.vitroglazings.com
glassed.vitroglazings.com

1.855.VTRO.GLS (1.855.887.6457)

7207 2/2019