Decorative Glass Product's Conformance to

The Leadership in Energy & Environmental Design Rating System

For New Construction and Major Renovations

Based on:

US Green Building Council, LEED® – NC Version 3

Canada Green Building Council, LEED® – NC Version 1 with Addendum

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Sustainability has been defined by the Brundtland Commission as "meeting the needs of the present generation without compromising the ability of future generations to meet their own needs." In architecture and construction, sustainability refers to reducing the environmental impact of building designs in the short term and in the long term, creating buildings and communities that are part of the natural world, being regenerative and supportive of all other living systems. [1] The main concern when developing the overall design of sustainable or "green" buildings is the integration of all of the components to ensure that everything works together and that, in the end, the whole is greater than the sum of its parts.

The Leadership in Energy and Environmental Design (LEED®) Green Building Rating System represents the U.S. and Canada Green Building Councils' effort to provide a national standard for what constitutes a "green building". Green design not only makes a positive impact on public health and the environment, it also reduces operating costs, enhances building and organizational marketability, potentially increases occupant productivity, and helps create a sustainable community.[2]

The LEED rating system is a voluntary, consensus-based national standard for developing high-performance, sustainable buildings. Although the USGBC and the CaGBC do not certify, promote, or endorse products and services of individual companies, products and services do play a role and can help projects with credit achievement. *Product manufacturers and service providers are vital to advancing the mission of market transformation.*

This document describes the ways in which decorative glass products manufactured by Goldray Industries Ltd. are consistent with the intent of the LEED Rating System. The information has been developed using general or typical information on Goldray glass products to allow our customers easier access to new construction or renovation projects through the use of decorative glass as a building material. Although individual building products do not in themselves constitute conformance to the LEED criteria, depending on the amount and type of glass used in a project, this versatile material has great potential to help achieve LEED credits.

This document is intended to provide general information only. Goldray does not make any warranty, either expressly or implied, as to the suitability or completeness of the information contained herein.

[1] Mendler S., Odell W., Lazarus M., *The HOK Guidebook to Sustainable Design*, John Wiley & Sons Inc., NJ 2006, 2nd Ed.
[2] U.S. Green Building Council, *LEED for New Construction Reference Guide*, Version 2.2, 2005

LEED Category: *Energy and Atmosphere*

Credit: EA Credit 1: Optimize Energy Performance
LEED Credit Range:
USGBC: 1-19 points (NC & Schools), 3 – 21 points (CS)
CaGBC: 1 – 10 points

Intent: To achieve increasing levels of energy performance beyond the prerequisite standard to reduce environmental and economic impacts associated with excessive energy use.

Decorative Glass Contribution:

This credit refers to strategies to optimize energy usage and performance. Four fundamental strategies are used to increase energy performance: reduce demand, harvest free energy, increase efficiency and recover waste energy. The use of glass in both the building envelope and interior components aids in harvesting site energy by increasing daylighting properties throughout the space and reducing the requirement for electric lighting.

Skylight and curtain wall performance can be enhanced through the right combination of glass construction, tints, and coatings. Adding decorative components to the glass surface also provides a measure of control to the light being introduced into each area. In addition, Low E and other solar control types of glass on the exterior of a building will increase the natural lighting while limiting the thermal effects of infrared energy and solar heat gain. This has the potential to generate savings from lower energy use, smaller equipment requirements as well as reduced space needs for mechanical and electrical equipment.

Furthermore, when performing energy modeling calculations manually operated shading devices such as blinds or window shades are ineligible under this credit. The permanent application of decorative techniques allow for this type of solar control to be included in the calculations.

Potential Strategies Involving Decorative Glass:

Potential Strategy: Reduce solar heat gain through exterior glazing parameters, utilize passive heating and cooling systems and reduce energy use.

Possible Applications: Exterior glazing insulated units in conjunction with low-e or reflective glass, exterior vision glazing with patterns, exterior fins/sunshades, operable louvers

Relevant Goldray Products: *Decorative Laminated Glass; DecoTherm Digital Ceramic Images; Satin Etch Glass; Silkscreened Glass with Ceramic Frit*

Potential Strategy: Maximize daylight harvesting to reduce the requirement for electric light.

Possible Applications: Atria; skylights; clerestory glazing; courtyards; energy efficient exterior glazing

Relevant Goldray Products: *Cast/Pattern Glass; Decorative Laminated Glass; DecoTherm Digital Ceramic Images; Satin Etch Glass; Silkscreened Glass with Ceramic Frit*

Potential Strategy: Provide glare control to increase lighting quality.

Possible Applications: Interior sunshading; interior glazing / partitions; light shelves; light redirecting glazing; glass furniture components

Relevant Goldray Products: *DecoTherm Digital Ceramic Images; Satin Etch Glass; Silkscreened Glass with Ceramic Frit*

Potential Strategy: Reduce energy required for ventilation by providing demand control natural ventilation.

Possible Applications: Operable windows; operable louvers

Relevant Goldray Products: *Cast/Pattern Glass; Decorative Laminated Glass; DecoTherm Digital Ceramic Images; Satin Etch Glass; Silkscreened Glass with Ceramic Frit; Technographic Interlayer*

Potential Strategy: Provide interior components to increase the daylight penetration deeper into the space.

Possible Applications: Glass stairways and flooring; glass railings and balustrades; interior glazing / partitions; furniture components; demountable partitions or sliding walls

Relevant Goldray Products: *Cast/Pattern Glass; Decorative Laminated Glass; DecoTherm Digital Ceramic Images; Satin Etch Glass; Silkscreened Glass with Ceramic Frit; Technographic Interlayer*

LEED Category: *Materials and Resources*
USGBC:
Credit: MR Credit 4.1: Recycled Content – 10% (post-consumer + ½ pre-consumer)
LEED Credit Range: 1 point

Credit: MR Credit 4.2: Recycled Content – 20% (post-consumer + ½ pre-consumer)
LEED Credit Range: 1 additional point

Intent: Increase demand for building products that incorporate recycled content materials, thereby reducing impacts resulting from extraction and processing of virgin materials.

CaGBC:
MR Credit 4.1: Recycled Content: 7.5% (post-consumer + ½ post-industrial)
MR Credit 4.2: Recycled Content: 15% (post-consumer + ½ post-industrial)

Intent: Increase demand for building products that incorporate recycled content materials, therefore reducing impacts resulting from extraction and processing of new virgin materials and by-passing energy and greenhouse gas-intensive industrial and manufacturing processes.

Decorative Glass Contribution – Although float glass manufacturers typically use 20% pre-consumer recycled materials in their manufacturing process, for the purpose of this LEED Credit, this is considered *reused* rather than *recycled* material and is specifically excluded for credit.

Although LEED credits do not apply, some types of decorative glass are completely recyclable at the end of their useful life if not previously contaminated with glazing materials. Examples of this are clear and cast glass, satin etch and glass silkscreened with ceramic enamels or with digital ceramic images applied. Laminated glass, mirror and some other types of coatings are not recyclable. Interested parties are encouraged to contact their local recycling facilities for information on the recyclability of specific products.

Most decorative glass products in themselves are not applicable to the recycled content credit, however, many framing systems are made with a high percentage of recycled aluminum or other metals and decorative glass can be incorporated into the design of floors, walls, ceilings and exterior glazing.

Potential Strategy: Modular designs for flooring and walls can be reconfigured easily to enhance long-term flexibility as the needs of the building occupants change. Many modular products are completely deconstructable, can be disassembled and are manufactured using recycled content.

Possible Applications: Modular glass flooring; systems furniture; demountable partitions or sliding walls

Relevant Goldray Products: *Cast/Pattern Glass; Decorative Laminated Glass; DecoTherm Digital Ceramic Images; LCBA Opaque Coated Glass; Satin Etch Glass; Silkscreened Glass with Ceramic Frit; Technographic Interlayer; Traction Control Flooring*

LEED Category: *Indoor Environmental Quality*

USGBC:

Credit: IEQ Credit 6.1: Controllability of Systems: Lighting (not available for CS)

LEED Credit Range: 1 point

Intent: Provide a high level of lighting system control by individual occupants or groups in multi-occupant spaces (i.e. classrooms or conference areas) and promote their productivity, comfort and well-being.

CaGBC:

EQ Credit 6.1: Controllability of Systems: Perimeter Spaces

EQ Credit 6.2: Controllability of Systems: Non-Perimeter Spaces

Intent: Provide a high level of thermal, ventilation and lighting system control by individual occupants or specific groups in multi-occupant spaces (i.e. classrooms or conference areas) to promote the productivity, comfort and well-being of building occupants.

Decorative Glass Contribution: This credit refers to adjustable lighting for individual tasks or in common areas. Integration of surface materials selection (i.e. high reflectance surfaces) and lighting design may create opportunities to reduce the number of installed lighting fixtures. Daylighting can be integrated within the ambient lighting scheme to compensate for the reduced footcandle levels. When daylighting is used as a component of the lighting design, glare control is also necessary.

Potential Strategy: Provide high reflectance surfaces to coordinate with lighting design.

Possible Applications: Laminated glass ceiling tiles with diffused or light colored interlayers (90% or greater reflectivity); light colored glass wall cladding; glass marker boards; interior light shelves

Relevant Goldray Products: *Decorative Laminated Glass; DecoTherm Digital Ceramic Images; LCBA Opaque Coated Glass; Silkscreened Glass with Ceramic Frit; Technographic Interlayer; Traction Control Flooring*

Potential Strategy: Provide glare control as a component of daylighting strategy.

Possible Applications: Interior sunshading; interior partitions; light shelves; light redirecting glazing; louvers; exterior fins / canopies / sunshading; acid etched rear projection screens; doors and windows; demountable partition systems; glass furniture components

Relevant Goldray Products: *Decorative Laminated Glass; DecoTherm Digital Ceramic Images; Satin Etch Glass; Silkscreened Glass with Ceramic Frit; Technographic Interlayer*

Potential Strategy: Provide interior components to increase the daylight penetration deeper into the space.

Possible Applications: Glass stairways and flooring; glass railings and balustrades; interior glazing / partitions; furniture components; demountable partitions or sliding walls; interior doors

Relevant Goldray Products: *Cast/Pattern Glass; Decorative Laminated Glass; DecoTherm Digital Ceramic Images; Satin Etch Glass; Silkscreened Glass with Ceramic Frit; Technographic Interlayer*

LEED Category: *Indoor Environmental Quality*

Credit: IEQ Credit 8.1: Daylight & Views: Daylight 75% of Spaces
LEED Credit Range: 1 – 2 points (NC & CS), 1 – 3 points (Schools)

Intent: To provide for the building occupants a connection between indoor spaces and the outdoors through the introduction of daylight and views into the regularly occupied areas of the building.

Decorative Glass Contribution (for Credit 8.1 and 8.2): This credit addresses the availability of daylight to a building's occupants. When designing for maximum daylight, designers must evaluate and balance a number of environmental factors, such as heat gain and loss, glare control, visual quality and variations in daylight availability.

Decorative glass can be used in a variety of applications and help achieve LEED credits by increasing the daylight factor within a building. By using glass to provide the connection between indoor occupants and the outdoors, building designers can also offer the added benefits of a low maintenance product and superior sound control. Many decorative techniques can also be used as glare control or to vary the degree of light transmission, making decorative glass a versatile material for use in floors, walls, ceilings, and furniture, as well as in the more traditional doors and windows.

Potential Strategy: Maximize daylight harvesting to provide the connection between indoor spaces and the outdoors.

Possible Applications: Atria; skylights; clerestory glazing; courtyards or indoor green Spaces; energy efficient exterior glazing; interior glazing / partitions; doors and windows

Relevant Goldray Products: *Cast/Pattern Glass; Decorative Laminated Glass; DecoTherm Digital Ceramic Images; Satin Etch Glass; Silkscreened Glass with Ceramic Frit; Technographic Interlayer*

Potential Strategy: Reduce heat gain/loss through exterior glazing parameters and reduce energy use.

Possible Applications: Low E or reflective exterior glazing; exterior vision glazing with silkscreened patterns; exterior fins / sunshades; operable louvers; exterior light shelves

Relevant Goldray Products: *Decorative Laminated Glass; DecoTherm Digital Ceramic Images; Silkscreened Glass with Ceramic Frit; Technographic Interlayer*

Potential Strategy: Provide interior components to increase daylight factor.

Possible Applications: Interior light shelves; light redirecting glazing; high reflectance ceiling or wall tiles; interior glazing / partitions; conference room and office walls with privacy decoration that still allows light penetration; interiors doors; demountable partitions or sliding walls

Relevant Goldray Products: *Cast/Pattern Glass; Decorative Laminated Glass; DecoTherm Digital Ceramic Images; Satin Etch Glass; Silkscreened Glass with Ceramic Frit; Technographic Interlayer*

Potential Strategy: Provide interior components to increase the daylight penetration deeper into the space.

Possible Applications: Glass stairways and flooring; glass railings and balustrades; interior glazing / partitions; furniture components; interior doors; demountable partitions or sliding walls

Relevant Goldray Products: *Cast/Pattern Glass; Decorative Laminated Glass; DecoTherm Digital Ceramic Images; Satin Etch Glass; Silkscreened Glass with Ceramic Frit; Technographic Interlayer; Traction Control Flooring*

Potential Strategy: Provide glare control to increase lighting quality.

Possible Applications: Interior sunshading; interior glazing / partitions; light shelves; louvers; light redirecting glazing; glass furniture components; exterior sunshading / fins; acid etched rear projection screens; demountable partitions or sliding walls; doors and windows

Relevant Goldray Products: *Decorative Laminated Glass; DecoTherm Digital Ceramic Images; Satin Etch Glass; Silkscreened Glass with Ceramic Frit; Technographic Interlayer*

Potential Strategy: Reduce the incidents of bird collisions with exterior glazing.

Possible Applications: Exterior sunshading / fins; exterior vision glazing with silkscreened patterns; exterior glazing with reduced apparent transparency and reflectivity through decorative techniques

Relevant Goldray Products: *Cast/Pattern Glass; Decorative Laminated Glass; DecoTherm Digital Ceramic Images; Satin Etch Glass; Silkscreened Glass with Ceramic Frit; Technographic Interlayer*

LEED Category: *Indoor Environmental Quality*

Credit: IEQ 8.2: Daylight & Views: Views for 90% of Spaces
LEED Credit Range: 1 point

Intent: Provide building occupants a connection to the outdoors through the introduction of daylight and views into the regularly occupied areas of the building.

Potential Strategy: Use glass to provide the connection between indoor occupants and the outdoors.

Possible Applications: Atria; skylights; clerestory glazing; courtyards and indoor green Spaces; gnergy efficient exterior glazing; doors and windows

Relevant Goldray Products: *Cast/Pattern Glass; Decorative Laminated Glass; DecoTherm Digital Ceramic Images; Silkscreened Glass with Ceramic Frit; Technographic Interlayer; Traction Control Flooring*

Potential Strategy: Develop indoor green spaces and incorporate glass components to increase viewing area.

Possible Applications: Atria; skylights; clerestory glazing; courtyards; energy efficient exterior glazing; interior doors; glass stairways and flooring

Relevant Goldray Products: *Cast/Pattern Glass; Decorative Laminated Glass; DecoTherm Digital Ceramic Images; Silkscreened Glass with Ceramic Frit; Technographic Interlayer; Traction Control Flooring*

Potential Strategy: Utilize interior glazing to increase areas with a direct line of sight to the outdoors, adding decorative components to reduce glare and add a measure of privacy.

Possible Applications: Glass stairways and flooring; glass railings and balustrades; interior glazing / partitions; furniture components; glass signage; interior doors; demountable partitions or sliding walls

Relevant Goldray Products: *Cast/Pattern Glass; Decorative Laminated Glass; DecoTherm Digital Ceramic Images; Satin Etch Glass; Silkscreened Glass with Ceramic Frit; Technographic Interlayer; Traction Control Flooring*

Potential Strategy: Provide colors, textures and patterns applied to glass to bring the effect of nature into the building's interior increasing overall satisfaction of occupants with their work environment.

Possible Applications: Atria; skylights; clerestory glazing; courtyards; glass stairways and flooring; glass railings and balustrades; interior glazing / partitions; furniture components; glass wall cladding; demountable partitions or sliding walls; interior doors and door inserts

Relevant Goldray Products: *Cast/Pattern Glass; Decorative Laminated Glass; DecoTherm Digital Ceramic Images; LCBA Opaque Coated Glass; Satin Etch Glass; Silkscreened Glass with Ceramic Frit; Technographic Interlayer; Traction Control Flooring*

LEED Category: *Indoor Environmental Quality*
USGBC
Credit: IEQ 9: Enhanced Acoustical Performance (for Schools only)
LEED Credit Range: 1 point

Intent: To provide classrooms that facilitates better teacher-to-student and student-to-student communications through effective acoustical design.

CaGBC: Not Available

Decorative Glass Contribution: Many types of decorative glass products are available in laminated, insulated, laminated insulated or double glazed form. The use of decorative glass in these types of glass systems allows for the combination of enhanced acoustical control with energy reduction, daylight harvesting, glare control and the introduction of views.

Potential Strategy: Increase the STC rating of exterior glass to mask exterior background noise.

Possible Applications: Skylights; clerestory glazing; energy efficient exterior glazing; doors and windows

Relevant Goldray Products: *Double glazed, insulated or laminated glass containing: Cast/Pattern Glass; Decorative Laminated Glass; DecoTherm Digital Ceramic Images; Satin Etch Glass; Silkscreened Glass with Ceramic Frit; Technographic Interlayer*

Potential Strategy: Increase the STC rating of interior glass to mask both interior and exterior background noise.

Possible Applications: Clerestory glazing; courtyards; interior glazing / partitions; furniture components; glass wall cladding; interior doors and door inserts; demountable partitions or sliding walls to separate instructional areas

Relevant Goldray Products: *Double glazed, insulated or laminated glass containing: Cast/Pattern Glass; Decorative Laminated Glass; DecoTherm Digital Ceramic Images; Satin Etch Glass; Silkscreened Glass with Ceramic Frit; Technographic Interlayer; Traction Control Flooring*

POTENTIAL ID CREDITS

LEED Category: *Innovation in Design*

Credit: ID 1: Innovation in Design
USGBC LEED Credit Range: 1 – 5 points (1 – 4 points for Schools)
CaGBC LEED Credit Range: 1 – 4 points

Intent: To provide design teams and projects the opportunity to achieve exceptional performance above the requirements set by the LEED Green Building Rating System and/or innovative performance in Green Building categories not specifically addressed by the LEED Green Building Rating System.

Potential ID Credit #1:

LEED Category: *Indoor Environmental Quality*

Credit: EQ Credit 4.2: Low Emitting Materials: Paints and Coatings
LEED Credit Range: 1 point

Intent: Reduce the quantity of indoor air contaminants that are odorous, irritating and/or harmful to the comfort and well-being of installers and occupants.

Decorative Glass Contribution: The intent of this credit is to limit VOC's in the paints and coatings that are applied on-site. Decorative glass offers many products that have factory applied coatings with no VOC's. The use of decorative glass in place of walls, doors, floors, ceilings and furniture provides a wide range of design options with no VOC's being introduced into the site. Unlike drywall or millwork, decorative glass products need no repainting, refinishing or similar maintenance which eliminates VOC's and irritating fumes from periodic maintenance. Glass coatings contain no hazardous content and do not generate hazardous waste during construction unlike solvent-based paints and adhesives. They also require no hazardous materials to clean up after installation or during maintenance.

Potential Strategy: Replacement of traditional building materials.

Possible Applications: Glass stairways and flooring; glass railings and balustrades; interior glazing / partitions; furniture components; glass wall cladding; glass signage; elevator cab interiors; glass canopies; feature walls; demountable partitions or sliding walls; glass counter tops / desk tops; doors and door inserts; ceiling tiles; operable windows & louvers

Relevant Goldray Products: *Cast/Pattern Glass; Decorative Laminated Glass; DecoTherm Digital Ceramic Images; LCBA Opaque Coated Glass; Satin Etch Glass; Silkscreened Glass with Ceramic Frit; Technographic Interlayer; Traction Control Flooring*

Potential ID Credit #2:

Intent: To build a comprehensive, interactive educational program within the LEED certified building to demonstrate and promote the use of sustainable building features and practices.

Decorative Glass Contribution: An educational outreach program could include features such as a visitor's center, interactive display or video, comprehensive signage program or built-in windows to view the energy saving components of the building. The durability, design flexibility and low maintenance properties of decorative glass make this a valuable material to use for protecting or enhancing the features of the space or to impart information through signage and exhibits.

Potential Strategy: Use decorative glass signage to illustrate the sustainable design features within the building.

Possible Applications: Decorative glass signage; wayfinding components

Relevant Goldray Products: *Cast/Pattern Glass; Decorative Laminated Glass; DecoTherm Digital Ceramic Images; LCBA Opaque Coated Glass; Satin Etch Glass; Silkscreened Glass with Ceramic Frit; Technographic Interlayer; Traction Control Flooring*

Potential Strategy: Use decorative glass screens mounted in the walls or floors to impart information as well as protect interactive displays, televisions or computer screens.

Possible Applications: Decorative glass signage; wayfinding components; glass screens mounted in the floors or walls; exhibit features

Relevant Goldray Products: *Cast/Pattern Glass; Decorative Laminated Glass; DecoTherm Digital Ceramic Images; LCBA Opaque Coated Glass; Satin Etch Glass; Silkscreened Glass with Ceramic Frit; Technographic Interlayer; Traction Control Flooring*

Potential Strategy: Incorporate built-in windows or glass flooring to view the energy saving mechanical equipment or other "green" components of the building.

Possible Applications: Viewing windows or floors that contain information/ instruction on the components being viewed

Relevant Goldray Products: *Cast/Pattern Glass; Decorative Laminated Glass; DecoTherm Digital Ceramic Images; LCBA Opaque Coated Glass; Satin Etch Glass; Silkscreened Glass with Ceramic Frit; Technographic Interlayer; Traction Control Flooring*

LEED Category: *Regional Priority*

Credit: RP 1: Regional Priority
USGBC LEED Credit Range: 1 – 4 points
CaGBC – Not Available

Intent: To provide an incentive for the achievement of credits that address geographically specific environmental priorities.

Requirements: Earn 1 – 4 of the 6 Regional Priority credits identified by the USGBC regional councils and chapters as having environmental importance for a project's region. A database of Regional Priority credits and their geographic applicability is available on the USGBC website; http://www.usgbc.org.

One point is awarded for each Regional Priority credit achieved; no more than 4 credits identified as Regional Priority credits may be earned. Projects outside of the U.S. are not eligible for Regional Priority credits.

Understanding Regional Priority Credits: RPCs are not new LEED credits, but instead are existing credits that USGBC chapters and regional councils have identified as being particularly important for their areas. The incentive to achieve the credits is in the form of a bonus point. If an RPC is earned, then a bonus point is awarded to the project's total points.

Project teams do not need to attempt these credits in addition to the existing LEED credits they are attempting. Upon project registration, LEED Online automatically determines a project's RPCs based on it ZIP code. If a project earns an RPC, it will also earn the associated bonus point.

For more information and a complete list of RPCs available by ZIP code, visit the USGBC website at http://www.usgbc.org.