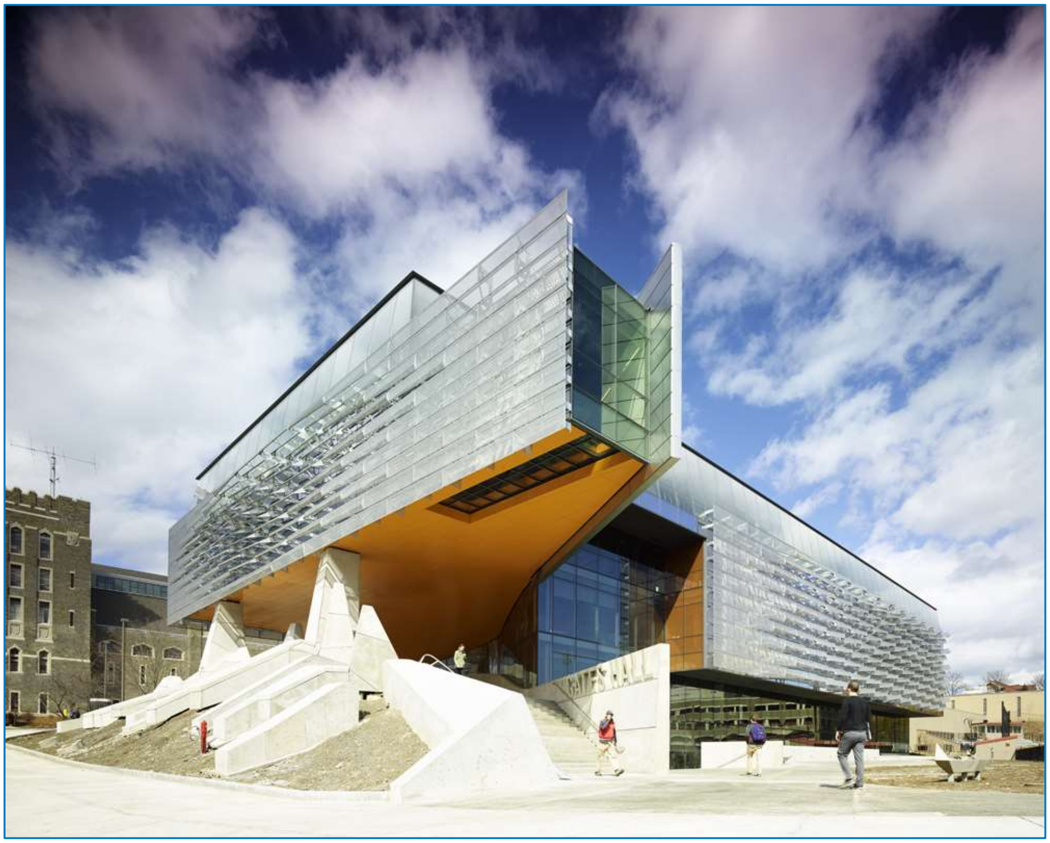
Viracon High Performance Insulating Glass Unit



Gates Hall - Cornell University

1” Clear Insulating Low-E Coated Glass Unit with a 9/16" Silicone Sightline with a ½” VTS Airspace and Both Lites Heat Treated

Environmental Product Declaration

Conducted in accordance with ISO 14025 and ISO 21930

EPDs are not intended to make comparisons with other products due to varying background data in LCA softwares and/or varying Program Operator rules or Product Category rules. The EPD and PCR process are informational only and do not warrant performance.

EPD SUMMARY

PROGRAM OPERATOR	ASTM International, 100 Barr Harbor Drive, West Conshohocken, PA, 19428. https://www.astm.org/
DECLARATION HOLDER	Viracon, Inc. 800 Park Drive, Owatonna, MN 55060, +1 507-451-9555, https://www.viracon.com/
DECLARATION NUMBER	562
DECLARED PRODUCT & UNIT	Viracon 1" Clear Insulating Low-E Coated Glass Unit with a 9/16" Silicone Sightline with a ½" VTS Airspace and Both Lites Heat Treated, per declared unit of 1 m^2
DATE OF ISSUE	September 15, 2023
PERIOD OF VALIDITY	Valid through September 14, 2028
REFERENCE PCR	UL Environment. PCR Guidance for Building-Related Products and Services. Part B: Processed Glass EPD Requirements. Standard 10010-31, Edition 1, dated 17 Aug. 2016, ext. through 6 Dec. 2023. Reviewed by: Chair: Tom Gloria, LCACP, Industrial Ecology Consultants; Jack Geibig, Ecoform; Bill Stough, Sustainable Research Group
CONTENTS OF THE DECLARATION	☐ About Viracon ☐ Description of the product ☐ The Life Cycle Assessment ☐ Results and contribution analysis ☐ Limitations and comparability ☐ References

This declaration was independently verified by Tim Brooke, ASTM International, in accordance with ISO 14044:2006/Amd1:2017/Amd2:2020, ISO 14025:2006 and ISO 21930:2017. The UL Environment Part A: Calculation Rules for the Life Cycle Assessment and Requirements on the Project report serves as the core PCR. The verification was performed: ___ Internally _X_ Externally	
LCA conducted in accordance with ISO 14044 and the reference PCR by:	Anne Landfield Greig, LCACP, Four Elements Consulting, LLC https://www.fourelementsllc.com anne@fourelementsllc.com
LCA independently verified in accordance with ISO 14044 and the reference PCR by:	Lindita Bushi, PhD., Athena Sustainable Materials Institute lindita.bushi@athenasmi.org

Viracon, Inc.

The exterior glass is the first impression of a building when arriving and the last impression when leaving; Viracon continuously monitors the quality of its fabrication processes – providing high performance glass units that will reflect perfectly on the building owner and its occupants.

Viracon® is the nation's only single-source, single-warranty architectural glass fabricator providing high-performance glass solutions including insulating, tempered, laminated, silk-screened, digital printed, hurricane-resistant, acoustical, blast-mitigating, electronic eavesdropping mitigating, electrochromic smart glass, and a broad selection of proprietary solar control coatings for commercial buildings.

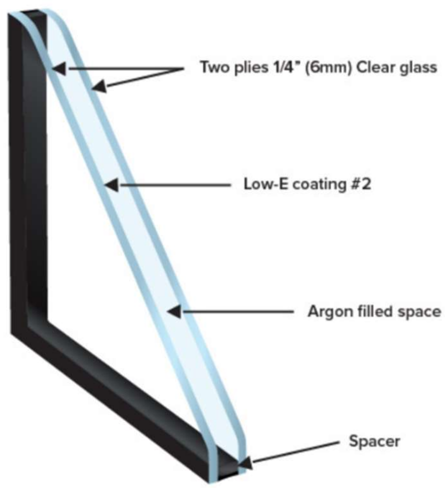
Viracon demonstrates an unwavering commitment to sustainability through its comprehensive practices and innovative solutions. With a deep understanding of the environmental impact of its operations, Viracon actively seeks ways to minimize its carbon footprint and conserve natural resources. Through continuous research and development, the company focuses on creating energy-efficient glass products that enhance building performance and improve occupant comfort while reducing energy consumption. Viracon also emphasizes responsible sourcing and manufacturing processes, employing sustainable materials and investing in technologies that reduce waste and emissions. By embracing sustainable practices throughout its entire supply chain and advocating for environmentally conscious designs with architects, Viracon strives to continue to contribute to a greener and more sustainable future.

The company is a subsidiary of Apogee Enterprises, Inc. (NASDAQ: APOG). Apogee, headquartered in Minneapolis, is a leader in technologies involving the design and development of value-added glass products and services.

ASTM INTERNATIONAL

Product System

Product Description



An insulating glass unit (IGU) is made up of two or more plies of glass that enclose a hermetically sealed space. This EPD covers a 1-in thick, two-pane clear glass IGU with low-E coating on one side of one pane of glass. Both panes are 6 mm thick and tempered. Sample schematic is at left. The warm edge spacer, Viracon Thermal Spacer (VTS^{TM}), replaces the traditional metal spacer-desiccant-primary sealant combination. VTS^{TM} consists of a black thermoplastic with integrated desiccant and primary seal and is chemically bonded directly to the glass and secondary sealant. Argon gas is used in the airspace. The low-e coating on the product is VNE-63; Viracon also utilizes the following low-e coatings on a regular basis: VE-42, VE-85, VE-2M, VRE-65, VRE-54, VRE46, VRE-38, VRE47/25, VRE47/22, VRE3117, VUE-50, VUE-40, VUE-30, VNE-63, VNE-53, and VNG40-22. The UNSPSC code for insulating glass products is 30171710.

Application

Viracon’s insulating glass units with high-performance coated glass are used on façades of various types of commercial buildings such as office towers, public works projects, hotels, educational institutions, healthcare facilities, and retail establishments.

Placing on the Market

Viracon’s insulating glass units are ordered to size; the units in this EPD are offered in sizes of up to 129-13/16 in x 236 in (3.3 m x 6.0 m). They are certified under the AAMA standards for windows, doors, and skylights.

Viracon’s IGUs meet the following technical specifications and performance standards:

- ASTM C1036: Standard specification for flat glass
- ASTM E2190: Standard specification for insulating glass
- ASTM C1048: Industry standard for heat treated glass
- ANSI Z97.1: Safety standard for glazing materials used in buildings
- CPSC 16 CFR 1201: Safety standard for architectural glazing materials, Cat. I and II
- ASTM E2188: Standard test method for insulating glass unit performance
- ASTM E2189: Standard test method for testing resistance to fogging in insulating glass units

- Certification through Insulating Glass Certification Council (IGCC)
- ASTM C1376 Standard Spec. for Pyrolytic & Vacuum Deposition Coatings on Flat Glass
- ASTM C1172 Standard Specification for Laminated Architectural Flat Glass

Manufacturing

Glass substrates are brought to the facility and cut down to custom sizes. In order to improve the thermal and optical performance characteristics, the glass is run through a coater where either a reflective or low-E coating is sputtered onto the second surface of the glass. The glass may also undergo silk-screening or digital printing. It may undergo specialty fabrication, such as notches, holes, and/or special edgework. The glass goes through tempering heat treatment to provide greater safety and resistance to wind loads, snow loads, thermal stress and shock. For this, glass edges undergo seaming and the glass is put through a furnace and heated to over 1,100 degrees F; after removal it is force-cooled. The glass may go through a heat soak oven treatment when safety glazing is required.

To assemble the insulating glass unit, Viracon’s VTS™ spacer is extruded between the glass lites and a secondary sealant is applied. The insulated space is filled with argon gas. The completed unit is tested, cleaned, and loaded onto a rack ready for distribution.

Packaging

Packaging Material	kg / m^2
Lumber	1.67
Polyethylene foam pads	0.068
Steel banding, nails, rack	0.200
Polypropylene strapping	0.009

Viracon packages its products using steel racks or wood shipping crates with foam pads and steel banding or returnable wood racks with plastic banding. The weighted average of the materials per declared unit are provided at left.

Table 1 Packaging materials

Environment and Health During Manufacturing and Use

During manufacturing, no environmental and health protection measures exceeding local and national regulations are necessary. No substances required to be reported as hazardous are associated with the production of this product.

To minimize environmental waste:

- Viracon uses computer applications to query and group incoming custom size orders, maximizing the use of glass out of each substrate, minimizing scrap glass.
- The scrap glass, called cullet, is recycled and shipped to a third-party company that then grinds the glass down mainly for use in the production of fiberglass as well as road paint, asphalt and even sandblast material.

Viracon’s insulating glass units have no negative impacts to the environment or health during normal use. Rather, insulating glass units with Viracon’s specialized coatings and other features greatly enhance building occupants' safety and comfort. Viracon's coatings are designed to reflect infrared radiation while allowing visible light to pass through, which helps to improve energy efficiency in buildings and minimize the need for heating and cooling a space which reduces energy consumption and associated greenhouse gas emissions.

Furthermore, Viracon's insulating glass units with low-e coatings can enhance thermal comfort by reducing drafts and cold spots near windows. This helps maintain a more stable indoor temperature, leading to increased occupant comfort and reduced reliance on HVAC systems.

Last, Viracon's low-e coatings can selectively filter out certain wavelengths of light, including infrared radiation, while allowing visible light to pass through. This means that buildings with low-e coated glass can still benefit from ample natural daylight, reducing the need for artificial lighting during the day.

Re-use and End-of-Life

If carefully removed from a building during deconstruction, insulating glass units within their frames could be reused. An insulating glass unit could be sent to a recycler, where the glass could be recovered and ground for use as a recycled material in fiberglass, concrete, asphalt, sand blast material, or other applications.

Life Cycle Assessment

A cradle-to-gate Life Cycle Assessment (LCA) was completed on Viracon insulating glass units in accordance with ISO 14040 / ISO 14044, and the study was reviewed for conformance with ISO 14044, ISO 21930:2017, ASTM program operator rules, and the PCR Part A and subcategory Part B. The period under review was FY'23.

Declared Unit

The declared unit is one square meter (1 m^2) of an insulating glass unit produced at the Owatonna plant. A functional unit is not reported since the system boundaries are cradle-to-gate and no use phase over a reference service life has been modeled.

Declared Unit (m^2)	Mass (kg)	Conversion to 1 kg	Thickness (mm)	Interlayer mass (%)
1	30.99	0.032	25.4	n/a

Table 2 Declared data

System Boundary

Per requirements of the PCR subcategory, the LCA evaluated the cradle-to-gate of the insulating glass unit system. This includes: raw material extraction and processing (A1), transportation of the materials to the manufacturing plant (A2), and manufacturing (A3). This is depicted below in the context of the construction works life cycle (adapted from 21930:2017 Fig 1). This LCA follows the attributional LCA approach.

Table 3 EPD System Boundary Modules

A1-A3			A4-A5		B1-B7					C1-C4				D
PRODUCTION Stage			CONSTRUC-TION Stage		USE Stage					END-OF-LIFE Stage				Benefits & Loads
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	C1	C2	C3	C4	D
Extraction and upstream production	Transport to factory	Manufacturing	Transport to site	Installation	Product Use	Maintenance	Repair	Full replacement	Refurbishment	Deconstruction / Demolition	Transport to waste processing or disposal	Waste processing	Disposal of waste	Reuse, recovery, recycling potential
Mandatory			Scenarios		Scenarios B6 Operational energy use scenario B7 Operational water use scenario					Scenarios				Scenario
X	X	X	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND

Note: MND = module not declared

Figure 1 shows the A1-A3 modules as they pertain to the Viracon insulating glass unit system.

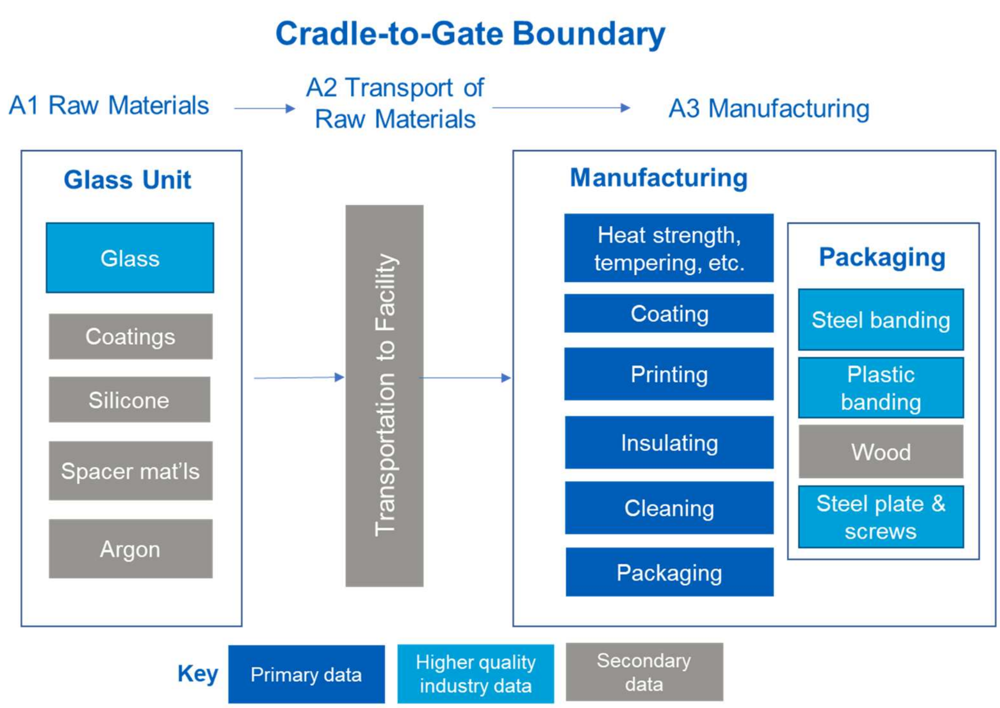


Figure 1 Viracon Insulating Glass Unit System Boundary and Data

A1 Raw Material Extraction and Processing

Material	% in Product
Glass: tempered, coated	48.4%
VTS airspace	1.3%
Silicon sealant	1.9%
Argon	0.06%
Glass: tempered	48.4%
Total	**100%**

A1 accounts for the extraction of materials and production of glass and other components in the insulating glass units. The table to left presents the material composition of the insulating glass unit.

Table 4 Material Composition

A2 Transportation to Manufacturing

A2 accounts for transportation of raw materials to Viracon's facility. The distances of the parts and materials by heavy duty diesel truck and rail were based on supplier data provided by Viracon.

A3 Manufacturing

A3 includes assembly of insulating glass units at the Owatonna facility. FY'23 energy and material use, emissions, and waste management were included in the model. The MRO West electricity grid mix was used for the production plant. Production of the packaging materials is also included here.

Cut-off Criteria

All efforts were made to include all known inputs of mass and energy flows and all known outputs. No known flows have been deliberately excluded from this EPD. Data gaps on materials were filled by proxy data deemed appropriate.

Allocation

Data was provided on a whole-facility basis since the vast majority of product output are insulating glass units. Allocation of manufacturing energy and other facility aspects was made on a total mass basis, based on the production volume. No burdens were allocated across the system boundary with secondary material, secondary fuel, or recovered energy flows arising from waste.

Software and Background Data

The SimaPro LCA software was used to model the insulating glass unit system. Data came from sources appropriate for the system, with intentional choices made for datasets having the highest quality data, including the use of supplier-specific EPDs. Secondary data came from several databases, including DATASMART for North American energy, transportation, parts and materials; ecoinvent for energy, parts and materials not included in DATASMART; and Industry 2.0 data.

Data Quality

The data applied to this study are representative of current Viracon insulating glass unit systems. Viracon’s facility supplied FY’23 process data. Energy and transportation data are based on the high 2010’s, and production data for materials are based on mid 2010’s through 2022. Data for energy, transportation, materials and processes are based on a combination of North American and European sources which, where possible, were customized to reflect North American conditions. Technological coverage for the upstream materials and processes is generally industry average, and in some instances, it is typical technology.

Results and Contribution Analysis

The Life Cycle Impact Assessment (LCIA) results were calculated using Tool for the Reduction and Assessment of Chemical and other Environmental Impacts (TRACI) v.2.1, a North American impact assessment methodology. Global Warming Potential is based on IPCC 5th Assessment. Abiotic Depletion Potential for fossil fuels is based on CML’s baseline methodology. These six impact categories plus total energy are globally deemed mature enough to be included in Type III environmental declarations. Other categories are being developed and defined and LCA should continue making advances in their development. However, the EPD users shall not use additional measures for comparative purposes. *LCIA results are relative expressions and do not predict impacts on category endpoints, the exceeding of thresholds, safety margins or risks.*

LCIA results in Table 5 and Table 6 are presented for the cradle-to-gate totals, showing A1, A2, and A3 as absolute values and as percentages, respectively. The Life Cycle Inventory (LCI) or non-LCIA metrics in Table 7 are calculated in accordance with the ACLCA (2019) Guidance. As shown in Table 6, for most categories, A1 is the highest contributor.

Table 5 Impact Assessment Results – absolute values

Per 1m^2 Declared Unit			Materials production	Transport to facility	Manuf-acturing
Impact Categories - LCIA	**Unit**	**TOTAL**	**A1**	**A2**	**A3**
Global warming potential	kg CO2-e	69.3	50.2	3.18	16.0
Acidification potential	kg SO2-e	0.315	0.212	0.018	0.085
Eutrophication potential	kg N-e	0.070	0.0191	0.00170	0.0492
Smog creation potential	kg O3-e	6.46	5.11	0.523	0.82
Ozone depletion potential	kg CFC11-e	1.89 E-04	1.88 E-04	5.58 E-09	5.14 E-07
Abiotic depletion potential fossil (ADP)	MJ (LHV)	923	711	39.7	173
Total energy (used as fuel)	MJ (LHV)	1070	769	40.3	261

Table 6 Impact Assessment Results – percentages

Per 1m² Declared Unit			Materials production	Transport to facility	Manuf-acturing
Impact Categories - LCIA	**Unit**	**TOTAL**	**A1**	**A2**	**A3**
Global warming potential	kg CO2-e	69.3	72.4%	4.59%	23.1%
Acidification potential	kg SO2-e	0.315	67.4%	5.75%	26.9%
Eutrophication potential	kg N-e	0.070	27.3%	2.43%	70.3%
Smog creation potential	kg O3-e	6.46	79.1%	8.10%	12.8%
Ozone depletion potential	kg CFC11-e	1.89 E-04	99.7%	0.00%	0.27%
Abiotic depletion potential fossil (ADP)	MJ (LHV)	923	77.0%	4.30%	18.7%
Total energy (used as fuel)	MJ (LHV)	1070	71.9%	3.77%	24.4%

Note: numbers may not add to 100% due to rounding. 0.00% implies less than 0.005%.

Table 7 Inventory Results

Per 1 m² Declared Unit			Materials prod'n	Transport to facility	Manuf-acturing
Additional Categories – LCI	**Unit**	**TOTAL**	**A1**	**A2**	**A3**
Resource Use: Energy					
Non-renewable primary energy - fuel	MJ (LHV)	993	742	40.3	211
Non-renewable prim. energy res. - raw mat'ls	MJ (LHV)	0.00	0.00	N/A	0.00
Renewable primary energy – fuel	MJ (LHV)	77	27.4	0.09	49.8
Renewable primary energy res - raw matl's	MJ (LHV)	0.00	0.00	N/A	0.00
Resource use: Materials					
Use of secondary materials	kg	1.00	1.00	N/A	0.00
Use of renewable secondary fuels	MJ (LHV)	0.00	N/A	N/A	0.00
Use of non-renewable secondary fuels	MJ (LHV)	0.00	N/A	N/A	0.00
Use of recovered energy	MJ (LHV)	0.00	N/A	N/A	0.00
Use of net fresh water (inputs minus outputs)	m^3	93.9	93.7	3.52 E-04	0.219
Waste categories					
Non-hazardous waste disposed	kg	0.391	N/A	N/A	0.391
Hazardous waste disposed	kg	0.00	N/A	N/A	0.00
High-level radioactive waste	kg	1.21 E-04	1.06 E-05	1.70 E-06	1.09 E-04
Intermediate- & low level radioactive waste	kg	3.07 E-04	6.07 E-05	3.78 E-06	2.42 E-04
Other output flows					
Components for reuse	kg	0.00	0.00	0.00	0.00
Materials for recycling	kg	4.21	0.90	0.00	3.30
Materials for energy recovery	kg	0.00	0.00	0.00	0.00
Exported energy	MJ (LHV)	0.00	0.00	0.00	0.00

Limitations & Comparability

Environmental declarations from different programs may not be comparable. EPDs are not intended for making comparisons with other products due to variations and deviations between LCAs and EPDs, including varying background data in LCA softwares and/or varying Program Operator or Product Category Rules. For example, Product Category Rules may present different modeling decisions or impact category requirements. Different LCA software and background LCI datasets may lead to different results in the life cycle stages declared.

Full conformance with the PCR for North American Processed Glass allows EPD comparability only when all stages of the life cycle have been considered, including the product’s use phase in a building. The life cycle stages beyond cradle-to-gate are not permitted under this PCR. EPDs are comparable only if they comply with ISO 21930:2017, use the same sub-category PCR, include all relevant information modules, and are based on equivalent scenarios with respect to the context of construction works. Nonetheless, variations and deviations, as noted above, are still likely. If comparisons to other EPDs are done, these variations and deviations must be acknowledged.

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