



# 3form<sup>®</sup> InfiniteGlass<sup>™</sup>

pressed glass panel

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3form Infinite Glass offers the timeless nature of glass with the 3form signature design aesthetic. The design choices of 3form Infinite Glass panels are as diverse as your imagination. By allowing you to custom select color, pattern, interlayer, and type of glass, 3form Infinite Glass transforms into the perfect medium for your architectural application.

**Environmental Information**

Declared Unit 1 meter squared  
Mass per Declared Unit 32.4 kg

Quantities per Declared Unit		
Life Cycle Impact Assessment [CML 2001]		
	Unit	Quantity
Global Warming	[kg CO <sub>2</sub> -eq]	92.1
Acidification	[kg SO <sub>2</sub> -eq]	0.353
Eutrophication	[kgPhosphate-eq]	0.0428
Ozone Depletion	[kg R11-eq]	3.77E-07
Photochemical Ozone Creation	[kg Ethene-eq]	0.0302
Abiotic Depletion, Elements	[kg Sb-eq]	2.36E-04
Abiotic Depletion, Fossil	[MJ]	1,450
Life Cycle Inventory Indicators		
Secondary Materials	[kg]	0
Secondary Fuels	[MJ]	0
Freshwater Use	[m <sup>3</sup> ]	0.447
Non-renewable Energy	[MJ]	1,530
Renewable Energy	[MJ]	631
Hazardous Waste	[kg]	9.91E-03
Non-hazardous Waste	[kg]	3.77E-03
Radioactive Waste	[kg]	0.0310

EPD Information			
Program Operator		NSF International	
Declaration Holder		3form	
Infinite Glass	Date of Issue 10/29/2014	Period of Validity 3 years	Declaration Number EPD10038
This EPD was independently verified by NSF International in accordance with ISO 14025:		 Tom Bruursema Bruursema@nsf.org	
<input type="checkbox"/> Internal	<input checked="" type="checkbox"/> External		
This life cycle assessment was independently verified by in accordance with ISO 14044 and the reference PCR:		 Jack Geibig jgeibig@ecoform.com	
LCA Information			
Basis LCA		Life Cycle Analysis of Building Panels 9/19/2014	
		PE International Takuma Ono T.Ono@pe-international.com	
This life cycle assessment was critically reviewed in accordance with ISO 14044 by:		Jack Geibig EcoForm jgeibig@ecoform.com	
PCR Information			
Program Operator		The International EPD System	
Reference PCR		Construction Products and CPC 54 Construction Services	
Date of Issue		March 15, 2013	
PCR review was conducted by:		Martin Erlandsson, IVL Swedish Environmental Research Institute martin.erlandsson@ivl.se	

## Environmental Programs and Policies

### Sustainability Statement

We believe that we must be responsible for our products through their entire life-cycle, with a diligent focus on the balance of people, planet, and profit.

### Sustainability Platform

3form's sustainability initiatives are collectively known as Path to Zero, and include five main directives designed to minimize our footprint, while we create awardwinning building materials and architectural hardware solutions for the Architecture + Design industry:

- Zero Waste 1** Furthering 3form's successful zero-waste-to-landfill initiative, we have begun a path to become a Zero Waste manufacturing facility. This will be done through aggressive recycling, reduced waste creation, and innovative manufacturing.
- Carbon Neutrality 2** 3form is committed to energy and fuel efficiency measures, and the purchase of renewable energy credits (RECs) and verified emission reductions (VERs) to offset those emissions we do cause through our operations.
- Responsible Manufacturing 3** Social responsibility as well as environmental awareness have been integrated into 3form's manufacturing ethos.
  - Globally focused social equity is built through 3form's innovative Full Circle program, in which we direct-source artisan materials from developing regions in a manner that provides improved economic opportunity and health and education benefits, while also helping to protect community and cultural integrity.
  - Local social equity is also enhanced through corporate philanthropy, employee benefit programs, community engagement, and volunteerism.
  - Focused Life Cycle Assessments on 3form products, as well as awareness of material inputs, resource usage, and continuing improvements in manufacturing ensures 3form products meet stringent quality standards while making the least impact footprint from cradle to gate.
  - Incorporation of recycled materials is a hallmark of 3form, where product development teams work to create innovative products that use less virgin materials or non-renewable resources. Varia Ecoresin®, a flagship 3form product, contains an average of 40% preconsumer content, while other 3form products contain up to 100% recycled content.
  - Reclaim and Reform programs have been established to help ensure responsible management of 3form products, after their service life is over. Through these waste-reduction initiatives, 3form will take back used panels, and repurpose imperfect panels to give them another life and prevent them from entering the waste stream.
- Materials Transparency 4** Many 3form materials have independent certifications attesting to recycled content, indoor air quality friendly qualities, and other beneficial attributes. With a growing focus on healthy buildings, we have been investing in creating Environmental Product Declarations (EPDs), and Health Product Declarations (HPDs), to offer an exceptional level of transparency and assurance to our customers.
- Employee Engagement 5** This is 3form's sustainability in action by our team. On-going trainings, in-house audits, sustainability-focused clinics and activities, commute reduction rewards and consistent sustainability feedback help ensure that employees contribute to our goals, as well as have a personal understanding of their importance. We believe that sustainability should extend beyond 3form's workplace, and encourage employees to lessen their individual footprints in their daily lives.

**Sustainability  
Programs and  
Initiatives**



**US Green Building Council**

As a long-time member of the USGBC, 3form recognizes the importance of the LEED rating system to sustainable design. 3form materials help achieve LEED credits across a number of categories and were selected for use in the USGBC's headquarters in Washington DC. We are committed to promoting sustainable building practices and education through our national and local Chapter memberships.



**The Climate Registry**

3form achieved Climate Registered™ status by successfully measuring our carbon footprint according to The Climate Registry's best-in-class program, then having it third party verified and voluntarily reporting the data on The Climate Registry's website.



**ISO 14001:2004**

Environmental management standards to help organizations minimize how their operations negatively impact the environment; comply with applicable laws, regulations, and other environmentally-oriented requirements; and make continual improvements. 3form's facilities are certified ISO 14001.



**Scientific Certification Systems**

Offers a variety of certifications, including one for the use of recycled materials. All claims are certified in accordance with U.S. FTC Guides for the Use of Environmental Marketing Claims and ISO 14021 standards. Chroma is SCS certified for 38% recycled content.



**GREENGUARD**

Third party certification gives assurance that products and building materials designed for use indoors meet strict chemical emissions limits. Includes performance-based standards to define products and processes with low chemical and particle emissions.



**EPA Green Power Partnership**

A voluntary program of the U.S. EPA that recognizes companies for their procurement of green power. 3form is a member of the Green Power Leadership Club.



**Salt Lake City e2 Business**

The Salt Lake City environmentally and economically sustainable (e2) business program is designed to recognize and support the Salt Lake City business community and economy. 3form is an e2 Business.



**Emissions Offset**

Through 3Degrees, 3form supports Green-e Climate certified renewable energy projects. These projects avoid greenhouse gas emissions and help us offset the emissions we generate in our operations and business travel.

### Comparability

This EPD meets the requirements for comparability with products evaluated in accordance to the guiding PCR document. EPDs from different programs may not be comparable.



### Specification of the Product

General, mechanical, and thermal specifications for flat glass panels are summarized in Table 1.

PROPERTY*	CONDITIONS	ASTM METHOD	0.236" (6 MM)	
			SI	U.S.
<b>GENERAL</b>				
Declared Unit			1 m <sup>2</sup>	
Panel Mass			32.4 kg	
Panel Gauge			1.33 cm	
Panel Volume			0.0133 m <sup>3</sup>	
Density	23°C (73°F)	D 1505	2,440 kg/m <sup>3</sup>	152.3 lb/ft <sup>3</sup>
<b>MECHANICAL</b>				
Youngs Modulus	5.0 mm/min (0.2 in./min)	D 623	72 GPa	10,442,000 psi
Shear Modulus	1.27 mm/min (0.05 in./min)	D 623	2,000 GPa	4,350,000 psi
Flexural Strength	1.27 mm/min (0.05 in./min)	D 790	83 MPa	12,000 psi
Hardness (Moh's Scale)	—	—	—	6-7
Knoop Hardness	—	C1326	585 kg/mm <sup>2</sup>	832,065 lb/in <sup>2</sup>
Safety Glazing	75°F 23.8°C	ANSI Z97.1	PASSES	
<b>THERMAL</b>				
Continuous Max Use Temperature (Pressed Glass)	—	—	100°C	212°F
Coefficient of Thermal Expansion	—	E 831	8.6 10 <sup>-6</sup> /°C	—

Table 1: Select mechanical and physical properties for 3form flat glass

### Relevant Functional Properties

Tolerances for length, width, and squareness are based on ASTM C1048-04 ASTM Standard *Specification for Heat Treated Flat Glass* and C1172-03 Standard *Specification for Laminated Architectural Flat Glass*.

NOMINAL THICKNESS	ANNEALED		FULLY TEMPERED	
	Length and Width	Squareness	Length and Width	Squareness
¼" or less (6.0 mm or less)	n/a	n/a	n/a	n/a
>¼" - ½" (6.0 mm - 12.0 mm)	+1/4", -1/16" (+6.3 mm, -1.6 mm)	5/64" (2.0 mm)	+1/4", -1/8" (+6.3 mm, -3.2 mm)	5/64" (2.0 mm)
>½" (12.0 mm)	+1/4", -1/8" (+6.3 mm, -3.2 mm)	11/64" (4.4 mm)	+5/16", -1/8" (+7.9 mm, -3.2 mm)	11/64" (4.4 mm)

**Table 2: Length, width, and squareness tolerances**

Glass in the Fully Tempered condition is about four times more resistant to breakage than Annealed glass. However, the heating and cooling process used to produce Fully Tempered glass can cause the glass to have a slightly “wavy” appearance that can create subtle optical distortions at certain angles of view. Because of this, it is recommended that all mirror glass be specified as annealed whenever possible.

### Declared Unit



Since this analysis follows a basic module PCR, specific functions for each product category were not defined and are not necessary under the cradle-to-gate system boundary. Therefore, all products were evaluated on a per-m2 basis and will be analyzed under the declared unit of 1 m2 of panel product as sold by 3form.

The reference flow was determined by calculating the average Infinite Glass panel gauge produced in 2013, weighted by production masses. The reference flow for Infinite Glass panels is 32.4 kg.

### Content of Material and Chemical Substances

Infinite Glass is predominantly comprised of glass and moderate amounts of thermoplastic polyurethane. Auxiliary materials are also incorporated. The total material composition is summarized in Table 3. Materials comprising a minimum of 99% the product weight is included in the declaration.

Component	Percent composition
Glass lites	90 – 96%
TPU Adhesive	4 – 10%
Acrylic film	1 – 2%
Ethylene-vinyl acetate	< 1%
Flock cove (Polyester fabric)	< 1%
Polyethylene film	< 1%

Table 3: Primary and auxiliary material inputs by percentage composition

### System Boundaries

The PCR requires, at a minimum, to report environmental impacts of activities up to the factory gate, with subsequent life cycle stages optionally reported. This is considered by the PCR to be the cradle-to-gate system boundary. Life cycle stages beyond the gate (transportation to installation site, installation, maintenance, deconstruction, disposal, and recycling) are not considered in this declaration (refer to Table 4).

PRODUCT STAGE			CONSTRUCTION PROCESS STAGE		USE STAGE (not relevant)							END OF LIFE STAGE				BENEFITS AND LOADS BEYOND THE SYSTEM BOUNDARIES
Raw material supply	Transport	Manufacturing	Transport from the gate to the site	Assembly	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	De-construction demolition	Transport	Waste processing	Disposal	Reuse-Recovery-Recycling-potential
<b>A1</b>	A2	<b>A3</b>	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D

Table 4: The declared EN 15804 aggregation modules (A1, A2, A3) shown in bold blue borders

In accordance with the PCR, the reference service life (RSL) is not specified.

The geographic scope of the system is in North America; thus, the geographic validity of the EPD is also North America.

Electricity consumption is entirely from the regional grid mix of Salt Lake City.





## Environmental Impact Potentials

This section contains the absolute results for each product per the declared unit (Table 5) and a visual breakdown of the relative impacts (Figure 1), allowing for a more intuitive understanding of where impacts occur in the product life cycle. Biogenic carbon is excluded in the global warming potential calculations. The environmental inventory and impacts are reported per EN 15804, as follows:

### Environmental Impacts (CML 2001 and TRACI 2.1)

GWP	Global warming potential
ODP	Depletion potential of the stratospheric ozone layer
AP	Acidification potential of land and water
EP	Eutrophication potential
POCP	Formation potential of tropospheric ozone photochemical oxidants
ADPE	Abiotic depletion potential for non-fossil resources
ADPF	Abiotic depletion potential for fossil resources
POCP/SFP	Photochemical Ozone Creation Potential / Smog formation potential

### Resource Use

PENRT	Total use of non-renewable primary energy resources
PENRE	Use of non-renewable primary energy excluding non renewable primary energy resources used as raw materials
PENRM	Use of non-renewable primary energy resources used as raw materials
PERT	Total use of renewable primary energy resources
PERE	Use of renewable primary energy excluding renewable primary energy resources used as raw materials;
PERM	Use of renewable primary energy resources used as raw materials
SM	Use of secondary material
SF	Use of secondary renewable fuels
FW	Use of net fresh water

### Output Flows and Waste Categories

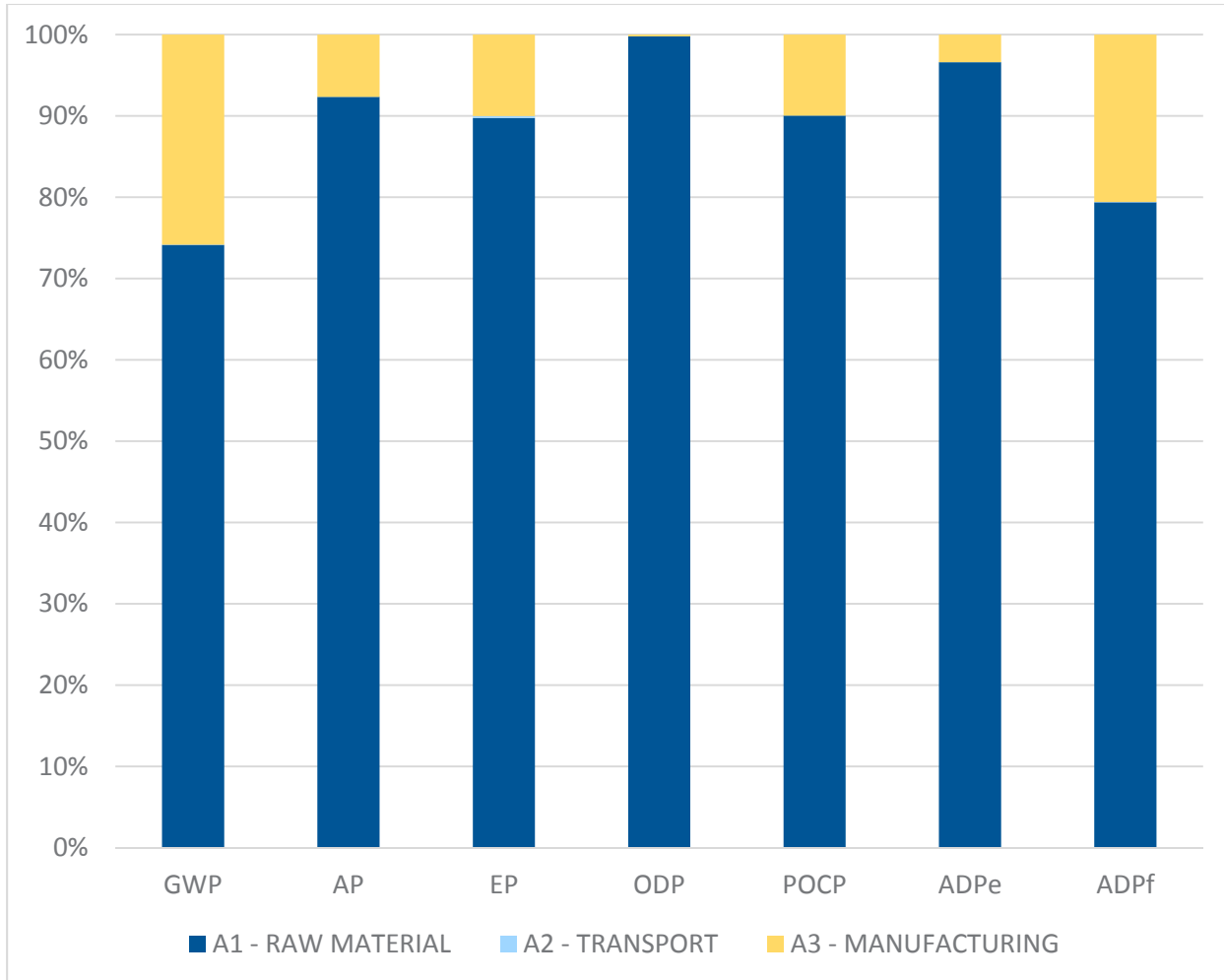
HWD	Hazardous waste disposed
NHWD	Non-hazardous waste disposed
RWD	Radioactive waste disposed

	UNIT	TOTAL	A1 - RAW MATERIAL	A2 - TRANSPORT	A3 – MANUFACTURING
<b>CML 2001 – April 2013</b>					
GWP	kg CO <sub>2</sub> -eq	92.1	68.3	0.0318	23.8
AP	kg SO <sub>2</sub> -eq.	0.353	0.326	2.42E-04	0.027
EP	kg Phosphate-eq	0.0428	0.0385	5.87E-05	4.26E-03
ODP	kg R11-eq.	3.77E-07	3.77E-07	2.69E-13	7.79E-10
POCP	kg Ethene-eq.	0.0302	0.0271	3.34E-05	3.03E-03
ADPe	kg Sb-eq.	2.36E-04	2.28E-04	4.08E-09	7.99E-06
ADPf	MJ	1450	1150	0.457	299
<b>TRACI 2.1</b>					
GWP	kg CO <sub>2</sub> -eq.	92.1	68.3	0.0318	23.8
AP	kg SO <sub>2</sub> -eq.	0.383	0.353	3.24E-04	0.0297
EP	kg N-eq.	0.165	0.160	2.07E-05	4.86E-03
ODP	kg CFC11-eq.	4.36E-07	4.35E-07	2.87E-13	8.28E-10
SFP	kg O <sub>3</sub> -eq.	6.32	5.75	0.0108	0.562
<b>Use of Resources</b>					
SM	kg	0	0	0	0
SF	MJ	0	0	0	0
FW	m <sup>3</sup>	0.447	0.215	0.000	0.232
PENRT	MJ	1530	1230	0.459	304
PENRE		1530	1.23E+03	4.59E-01	3.04E+02
PENRM		0	0	0	0
PERT	MJ	631	582	2.87E-03	48.9
PERE		85.5	36.6	2.87E-03	48.9
PERM		545	545	0	0
<b>Other Indicators Describing Waste Categories</b>					
HWD	kg	9.91E-03	9.91E-03	0	0
NHWD	kg	3.77E-03	3.77E-03	0	0
RWD	kg	3.10E-02	2.87E-02	9.50E-07	2.30E-03

**Table 5: CML and TRACI LCIA impacts, resource use, and waste categories for Infinite Glass panels, by EN 15804 life cycle modules**

Figure 1 shows visually that the module *A1 – Raw materials* is the dominant contributor cross all CML impact categories. The A1 module includes the primary panel resin and primary packaging materials. Moreover, 3form procures flat glass from suppliers, which are finished to specification at the Salt Lake City facility. Therefore, the upstream glass fabrication is considered an upstream burden, and not included in the module *A3 – Manufacturing*. When the 3form supply chain is apportioned to the EN 15804 life cycle modules, only the energy, water, and wastes generated during finishing is attributed to the A3 module.

*A3 – Manufacturing* is a significant contributor to impact categories Abiotic Depletion, fossil and Global Warming Potential. These two metrics are closely related, as consumption of fossil fuels invariably lead to greenhouse gas emissions. As such, the impacts at manufacturing are attributed to electricity and natural gas consumption.



**Figure 1: CML 2001 impacts by EN15804 life cycle modules**

The declared impacts represent the production-weighted average Infinite Glass panel gauge of 1.33 cm. However, 3form offers Infinite Glass panels ranging from 0.635 cm to 3.02 cm. Assuming the LCIA scales linearly by panel gauge, Infinite Glass panels can range from 48% to 227% of the declared quantities, depending on the product gauge.

**Release of Substances During the Use Stage**

3form Infinite Glass has a GREENGUARD Gold Certification and tested in accordance with UL 2821 test method to show compliance to emission limits on UL 2818. Section 7.1 and 7.2.



## Additional Environmental Information

### Installation

3form recommends that Infinite Glass be installed and handled by an experienced glazier. All labels should be removed promptly. If labels are left on for an extended period in elevated temperatures, they will leave a permanent mark.

### Cleaning and Maintenance Guidance

3form Infinite Glass, like all glass materials, should be cleaned periodically. Since glass products can be permanently damaged if improperly cleaned, 3form recommends strict compliance with the following procedures.

All dirt and residues that appear on interior or exterior glass surfaces should be cleaned thoroughly. Cleaning should begin with soaking the glass surfaces with clean water and soap to loosen dirt and debris. Using a mild, non-abrasive commercial window washing solution, uniformly apply the solution to the glass surfaces with a brush, strip washer or other non-abrasive applicator. Immediately following the application of the cleaning solution, a squeegee should be used to remove all cleaning solution from the glass surface. Care should be taken to ensure that no metal parts of the cleaning equipment come in contact with the glass surface. All water and cleaning solutions should be dried from the window gaskets and seals to avoid degradation of these materials.

### Disposal, Recycling, and Reuse

This product is not regarded as hazardous waste. Dispose in accordance with local regulations. 3form recommends used glass in good condition be placed into other suitable uses whenever possible.

As part of sustainability commitments, 3form takes responsibility for its products over their entire life cycle, when possible. 3form Reclaim program reuses and recycles materials removed from installations or from full-sized panels damaged in production. Pieces available through Reclaim meet 3form's rigorous quality control standards, and are considered first-quality, with professional trimming to final size, as listed.

3form also offers the Reform program, in which materials are made available at low cost. Reform materials are considered second-quality.

For more information, see <http://www.3-form.com/reclaim>.



## References

CML 2001	Guinée et al. “An operational guide to the ISO-standards (Centre for Milieukunde (CML), Leiden 2001.” Center for Environmental Sciences (CML) at the University of Leiden, The Netherlands. Last Updated 2010.
EN 15804	European Committee for Standardization (CEN). “EN15804:2012. Sustainability of construction works – Environmental product declarations— Core rules for the product category of construction products”
GaBi Databases 2013	PE International Inc. “GaBi Databases 2013”. November 2013. Documentation available at <a href="http://database-documentation.gabi-software.com/support/gabi/">http://database-documentation.gabi-software.com/support/gabi/</a>
ISO 14040	International Standard Organization. ISO 14040:2006-10, Environmental management – Life cycle assessment – Principles and framework (ISO 14040:2006).” German and English version EN ISO 14040:2006. Geneva. 2006
ISO 14044	International Standard Organization. “ISO 14044:200610, Environmental management – Life cycle assessment – Requirements and guidelines (ISO 14044:2006).” German and English version EN ISO 14044:2006 Geneva. 2006
EPD 2012	The International EPD System. 2012, January. Product Category Rules: Construction Products and CPC 54 Construction Services. Version 1.2.
BARE 2012	J. Bare, Tool for the Reduction and Assessment of Chemical and other Environmental Impacts (TRACI) - Software Name and Version Number: TRACI version 2.1 - User’s Manual, U.S. EPA, 2012.



## Contact Information



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