

## ENVIRONMENTAL PRODUCT DECLARATION

# ALUMINUM WINDOW SYSTEMS

YKK AP AMERICA, ENERGFACADE® ENERGY EFFICIENT BUILDING SOLUTIONS, PROTEK® HURRICANE MITIGATION AND BLAST MITIGATION SYSTEMS



*There are a large number of uses for architectural-grade windows. At Lee High School in Jacksonville, FL, YKK AP's operable windows were chosen in keeping with the historic look of the building.*

*All YKK AP® products are manufactured, finished, and inspected for quality in the YKK AP environmentally certified, state-of-the-art facility in Dublin, Ga.*



YKK AP America is taking positive steps toward sustainable manufacturing helping to balance ecology and economy—improving the environment and society over the long term. YKK AP® is the proud manufacturer of architectural products, including aluminum window systems, which provide safe and comfortable environments for building occupants and help reduce energy usage.

A dedicated partner in green building design and sustainability, YKK AP helps create innovative, high quality architectural systems that add to the strength, energy efficiency and longevity of the building envelope.

All YKK AP® products are created in a facility that is a model of environmental responsibility. YKK AP's U.S. manufacturing plant in Dublin, GA, is ISO 14001 certified and has been recognized by the U.S. Department of Energy for exceptional leadership in industrial energy efficiency.

For additional information, visit [commercial.ykkap.com](http://commercial.ykkap.com).



# ENVIRONMENTAL PRODUCT DECLARATION





YKK AP America  
Aluminum Window Systems

According to ISO 14025

This declaration is an environmental product declaration (EPD) in accordance with ISO 14025. EPDs rely on Life Cycle Assessment (LCA) to provide information on a number of environmental impacts of products over their life cycle. **Exclusions:** EPDs do not indicate that any environmental or social performance benchmarks are met, and there may be impacts that they do not encompass. LCAs do not typically address the site-specific environmental impacts of raw material extraction, nor are they meant to assess human health toxicity. EPDs can complement but cannot replace tools and certifications that are designed to address these impacts and/or set performance thresholds – e.g. Type 1 certifications, health assessments and declarations, environmental impact assessments, etc. **Accuracy of Results:** EPDs regularly rely on estimations of impacts, and the level of accuracy in estimation of effect differs for any particular product line and reported impact. **Comparability:** EPDs are not comparative assertions and are either not comparable or have limited comparability when they cover different life cycle stages, are based on different product category rules or are missing relevant environmental impacts. EPDs from different programs may not be comparable.



PROGRAM OPERATOR	UL Environment	
DECLARATION HOLDER	YKK AP America	
DECLARATION NUMBER	4786832322.107.1	
DECLARED PRODUCT	Aluminum Window Systems	
REFERENCE PCR	Part A: Calculation Rules for the LCA and Requirements Project Report, (IBU/UL E, V1.3, 06.19.2014), Part B: Requirements on the EPD for windows and doors (IBU, V1.7, 06.11.2014), Part B Addendum: IBU PCR for Windows and Doors (UL E, V1.0 Oct. 2015). Berlin: Institut Bauen, Umwelt.	
DATE OF ISSUE	November 13, 2015	
PERIOD OF VALIDITY	5 Years	
CONTENTS OF THE DECLARATION	Product definition and information about building physics Information about basic material and the material's origin Description of the product's manufacture Indication of product processing Information about the in-use conditions Life cycle assessment results Testing results and verifications	
The PCR review was conducted by:	IBU	
	The Independent Expert Committee	
This declaration was independently verified in accordance with ISO 14025 by Underwriters Laboratories <input type="checkbox"/> INTERNAL <input checked="" type="checkbox"/> EXTERNAL	 Wade Stout, UL Environment	
	 Thomas Gloria, Industrial Ecology Consultants	
This life cycle assessment was independently verified in accordance with ISO 14044 and the reference PCR by:		

# ENVIRONMENTAL PRODUCT DECLARATION



YKK AP America  
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## Product Definition

### Category Description

YKK AP is the single-source solution for architectural windows that are designed and engineered to provide worry-free, built-to-last quality. YKK AP® commercial window systems offer a variety of configurations to accommodate most any project requirement. This includes zero-sightline windows that may be installed in most YKK AP storefronts, window wall or curtain wall systems.

Windows with the ProTek® hurricane and blast mitigating designation are designed to protect buildings from the impacts of hurricanes and man-made disasters. These building systems have been independently tested to the requirements of ASTM E 1886, ASTM E 1996 and the test requirements for the Florida High Velocity Hurricane Zone (TAS 201, TAS 202, & TAS 203).

Commercial windows with the enerGfacade® energy saving solution designation utilize YKK AP's MegaTherm® thermal barrier technology to deliver up to 30% greater energy efficiency than traditional thermally broken systems. YKK AP commercial windows accept a variety of glazing options, spacers and gas fills for even greater efficiency and occupant comfort.

All YKK AP products are manufactured, finished and inspected for quality in YKK AP's environmentally certified, state-of-the-art facility in Dublin, GA. As a result, YKK AP products fit together without a lot of jobsite re-work. YKK AP offers a complete suite of tools and engineering services to assist in proper system selection, specification and installation.

#### Materials & Coatings

Aluminum Alloys:  
6063 T5, 6063 T6,  
6061 T6

Available Finishes:  
ANODIZED PLUS®,  
AAMA 2604/2605  
Painted Finishes

### Product Description

The following YKK AP America window systems are covered by this EPD (glazing is excluded from this study):



#### **YOW 350 XT 3-1/2" enerGfacade® Thermally Broken Operable Window System for Insulating Glass**

YOW 350 XT achieves state of the art energy performance while utilizing standard 1" insulating glass. Innovative design attributes minimize energy loss through a multitude of thermal barriers. This factory glazed window wall system has an overall depth of 3-1/2" and is thermally broken by a combination of MegaTherm® Thermal Breaks and gasketing to insulate multiple air chambers. Improved occupant comfort is achieved by interior surfaces that are significantly warmer than traditional window systems in cold climates.



#### **YOW 225 H 2-1/4" ProTek® Impact Resistant Operable Window**

YOW 225 H windows have been designed and engineered to the highest standards so as to provide a window that will be worry free. The windows have successfully passed the impact and cycle requirements of ASTM E 1886, ASTM E 1996, and the test requirements for the Florida High Velocity Hurricane Zone (TAS 201, TAS 202, & TAS 203). The windows are glazed with laminated monolithic glass. The vents are flush with the frame thus eliminating unsightly overlap.



# ENVIRONMENTAL PRODUCT DECLARATION



YKK AP America  
Aluminum Window Systems

According to ISO 14025



## **YOW 225 TUH 2-1/4" ProTek® Thermally Broken Impact Resistant Blast Mitigating Operable Window**

Performance boosting YOW 225 TUH windows now feature oversize window options and expanded installation options while providing an increase in school security over safety glazing. These additions eliminate job specific engineering and testing as maximum vent size increased from 15 SF to 24 SF with cost effective .090" PVB for LMI. Product specifications for YOW 225 TUH include openings to 7'-9" tall singles and doubles, or continuous window runs with stacking mullions. For larger openings, the operating windows can be installed in YKK AP impact rated storefront and curtain wall systems. The most cost effective and weather resistant configuration is a double casement in a master frame featuring a reduced sight line and no secondary penetrations of mullions or sill starter.



## **YFW 400 TUH 4" ProTek® Thermally Broken Impact Resistant and Blast Mitigating Fixed Window**

YFW 400 TUH ProTek® thermally broken impact resistant and blast mitigating fixed windows have been designed and engineered to the highest of standards. The quality 4" frame depth fixed window is universal to our 4" depth impact resistant operable window systems. This fixed window system will easily integrate with our YVS 410 TUH Single and Double Hung window system utilizing the same stacking mullions. Integral horizontal and vertical mullions provide greatly expanded configurations. Superior air and water performance enhance this factory glazed product making it an excellent substitution for smaller storefront punched openings. The YFW 400 TUH is a high performance window that is designed for the high velocity winds of south Florida. Additional benefit is provided by the labor savings when used as a factory glazed fixed window. This window system not only provides additional security against burglary but also the minimal hazard level of ASTM F 1642 for blast mitigation. With varied infill and components, YFW 400 TUH windows can meet the requirements for Impact Resistance and Blast Mitigation. So for your next window project, think YFW 400 TUH!



## **YVS 410 TUH 4" ProTek® Thermally Broken Side Loading Impact Resistant Blast Mitigating Hung Window**

The YVS 410 TUH ProTek® Hung Window is designed to capture the side rails of the sash, providing a high level of security and dependability for both new construction and renovation projects. The use of YKK AP's ThermoBond Plus® poured and de-bridged system provides superior thermal qualities. The windows have successfully passed the impact and cycle requirements of ASTM E-1886, ASTM E 1996, and the test requirements for the Florida High Velocity Hurricane Zone (TAS 201, TAS 202, & TAS 203). A full selection of quality block and tackle, spiral, and Class 5 Ultra-Lift® balances are available. Optional SecurSweep sweep locks are available that incorporate a special security latch to prevent tampering from the outside.



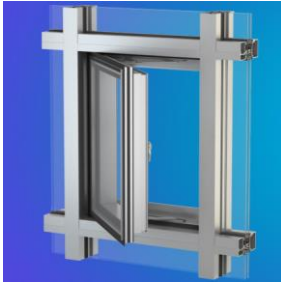


# ENVIRONMENTAL PRODUCT DECLARATION



YKK AP America  
Aluminum Window Systems

According to ISO 14025



## **YES SSG TUH Vent ProTek<sup>®</sup> 1-7/8" Thermally Broken Vent Window for Storefront, Window Wall and Curtain Wall**

Provide ventilation for your storefront or curtain wall project using a product that meets the 2012 International Energy Conservation Code (IECC) through Zone 6 with standard Low E (U = 0.29 COG). In addition to exceptional thermal performance and condensation resistance in an SSG Vent product, this system also provides AW PG 65 architectural performance. The YES SSG TU Vent seamlessly blends with the surrounding framing system to become virtually invisible when viewed from a distance.



## **YOW 350 T 3-1/2" Thermally Broken Operable Window System for Insulating Glass**

YOW 350 T windows have been designed and engineered to provide the highest level of performance. They have an overall depth of 3-1/2", the strength of 1/8" wall thickness, and are thermally broken by means of MegaTherm<sup>®</sup> technology to conserve energy, reduce operating costs, and allow for a dual finish option to fit design needs. This system, when coupled with its mullion options and full line of accessories, can be used as a factory glazed window wall system.



## **YOW 225 2-1/4" Operable Window for Monolithic & Insulating Glass**

YOW 225 windows have been designed and engineered to provide a quality window that will be worry free. The windows may be glazed with either monolithic or insulating units. The YOW 225 window system has been developed to provide a variety of configurations to accommodate project requirements. The vents are flush with the frame thus eliminating unsightly overlap. The windows may be installed as independent units or adapted to fit most YKK AP storefronts, window wall, or curtain wall systems.



## **YOW 225 TU 2-1/4" Thermally Broken Operable Window for Insulating Glass**

YOW 225 TU windows have been designed and engineered to provide the highest level of quality. The windows have an overall depth of 2-1/4" and are thermally broken by means of ThermaBond Plus<sup>®</sup> technology developed by YKK AP. YOW 225 TU windows may be installed as independent units or adapted to fit into most YKK AP storefront, window wall, or curtain wall systems. The vents are flush with the frame thus eliminating unsightly overlap. YOW 225 TU windows are available in a variety of configurations to accommodate project requirements.

# ENVIRONMENTAL PRODUCT DECLARATION



YKK AP America  
Aluminum Window Systems

According to ISO 14025



## YFW 400 TU 4" Thermally Broken Fixed Window

YFW 400 TU thermally broken fixed windows have been designed and engineered to the highest of standards. The quality 4" frame depth fixed window is universal to our 4" depth impact resistant operable window systems his fixed window system will easily integrate with our YVS 410 TU Single and Double Hung window system utilizing the same stacking mullions. Integral horizontal and vertical mullions provide greatly expanded configurations. Superior air and water performance enhance this factory glazed product making it an excellent substitution for smaller storefront punched openings. The YFW 400 TU is a high performance window. Additional benefit is provided by the labor savings when used as a factory glazed fixed window. This window system not provides additional security against burglary.



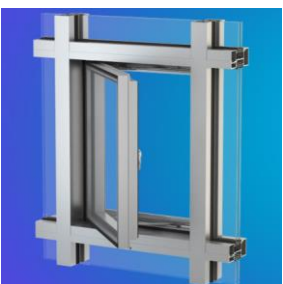
## YVS 400 TU 4" Thermally Broken Hung Window for Monolithic & Insulating Glass

The YVS 400 TU Hung Window is designed to tilt in for easy cleaning of the exterior glass surfaces from the inside of the building without removing the sash. To reduce the possibility of injury while cleaning the glass surfaces, optional SafSupport tilt arms are available on each side of the sash. YKK AP's ThermaBond Plus® poured and de-bridged system provides superior thermal qualities. Optional SecurSweep sweep locks incorporate a special security latch to prevent tampering from the outside. A full assortment of receptors, sill flashing, vertical and horizontal stacking mullions, panning, trim, muntins, and screens complete the window system.



## YVS 410 TU 4" Thermally Broken Side Loading Hung Window

The YVS 410 TU Hung Window is designed to capture the side rails of the sash, providing a high level of security and dependability for both new construction and renovation projects. The use of YKK AP's ThermaBond Plus® pour and debridge system provides superior thermal qualities and a patented process to prevent dry shrinkage. A full selection of quality block and tackle, spiral, and Class 5 Ultra-Lift® balances are available. Optional SecurSweep sweep locks are available that incorporate a special security latch to prevent tampering from the outside.



## YES SSG Vent. 2-3/4" Vent Window for Storefront, Window Wall and Curtain Wall

The YES SSG Vent enables designers to provide ventilation to architectural aluminum wall systems without adding the large. This product is an excellent choice for schools, offices and other commercial structures requiring ventilation. The vent seamlessly blends in with the surrounding framing system to become virtually invisible when viewed from a distance. Sightline of traditional windows.

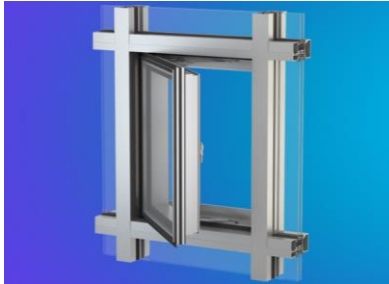


# ENVIRONMENTAL PRODUCT DECLARATION



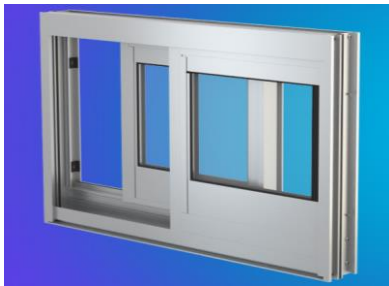
YKK AP America  
Aluminum Window Systems

According to ISO 14025



### YES SSG TU Vent Thermally Broken Vent Window for Storefront, Window Wall and Curtain Wall

Provide ventilation for your storefront or curtain wall project using a product that meets the 2012 International Energy Conservation Code (IECC) through Zone 6 with standard Low E (U = 0.29 COG). In addition to exceptional thermal performance and condensation resistance in an SSG Vent product, this system also provides AW PG 65 architectural performance. The YES SSG TU Vent seamlessly blends with the surrounding framing system to become virtually invisible when viewed from a distance.



### YSW 400 T 4" Thermally Broken Sliding Window for Monolithic & Insulating Glass

YSW 400 T is an architectural grade (AW) rated sliding window that offers ease of operation. The window is thermally broken by YKK AP MegaTherm® technology to conserve energy and reduce operating costs. Standard heavy-duty hardware provides years of worry free operation.



### YPI 1500 1-1/2" Interior Access Panel Windows

YPI 1500 is an interior secondary access panel window system designed for new and retrofit installations where enhanced thermal (heat and cold), sound (acoustical), or privacy performance are critical to occupant comfort. YPI 1500 can be integrated into most new and retrofit Storefront, Window Wall and Curtain Wall systems with little disruption to building occupants. When existing windows are weather-tight, and ventilation unnecessary, YKK AP interior accessory windows will improve thermal performance, reduce sound infiltration, and add privacy and security with optional between-glass Venetian blinds.

## Technical Performance

Name	Notes*	Value	Unit
Thermal Transmittance (U-Factor) (AAMA 1503.1, AAMA 507 and NFRC 100)	1, 2, 4	0.31 – 0.48	Btu/hr•ft <sup>2</sup> •°F
Solar Heat-Gain Coefficient (SHGC) (NFRC 200)	1, 2, 4	0.14 – 0.25	
Condensation Resistance Factor (CRFf) (AAMA 1503.1)	2, 3, 4	25 – 77	
<b>Water Infiltration (ASTM E 331 and AAMA 501.1)**</b>	<b>2</b>	<b>9 – 15</b>	<b>psf</b>
<b>Air Infiltration (ASTM E283, AAMA/NAFS 101/I.S.2/A440, NFRC 400 at 1.57 psf)**</b>	<b>2</b>	<b>0.20</b>	<b>cfm/ft<sup>2</sup></b>
Impact Resistance (ASTM E1886/1996, Testing Application Standard 201/202/203)	2, 3, 4	A, D	
Window Performance Class	2	AW, CW	
Performance Grade	2	40 – 100	

\* (1) Calculated based on U (Center of Glass) = 0.20 and SHGC (COG) = 0.25 (2) Varies by product type (3) Dependent on glazing specified  
(4) Based on products tested

\*\* Predominantly describes the framing

# ENVIRONMENTAL PRODUCT DECLARATION



YKK AP America  
Aluminum Window Systems

According to ISO 14025

## Industry Standards

AAMA: AAMA 1801, AAMA 910, AAMA 507, AAMA 1503, AAMA 501.5

ASTM: ASTM E1425, ASTM E90, ASTM E413, ASTM E1332, ASTM E2235, ASTM E283, ASTM F1642, ASTM E987, ASTM F2090, ASTM F588, ASTM E2068, ASTM E330, ASTM E331, ASTM E547

Other: NFRC 100, NFRC 102, NFRC 200, NFRC 500, NYC DOH

ProTek® hurricane and blast mitigation products: TAS 201, TAS 202, TAS 203, ASTM E1886, ASTM E1996

YKK AP® does not test or rate the declared products for extraordinary effects, i.e., performance under unforeseeable influence of fire, water or mechanical destruction.

## Base and Ancillary Materials

Material	Mass [kg]	Mass [%]
Aluminum 6063	1.44E+01 – 1.45E+01	65.2 – 65.8
Anodizing coat, optional	8.81E-02	<1
Paint coat, optional	4.79E-02	<1
MegaTherm (Nylon 6.6/Glass fiber)	2.74E-01	<1
ThermaBond (Polyurethane)	6.70E-02	<1
ABS	2.92E-03	<1
Aluminium part (external)	7.94E-03	<1
EPDM	2.09E+00	9.5
EVA	5.54E-05	<1
Nylon 6	8.66E-02	<1
Polyethylene	9.64E-04	<1
Polyisobutylene	6.28E-03	<1
Polypropylene	6.70E-02	<1
Polyurethane foam	1.82E-01	<1
PVC	6.14E-02	<1
PVC foam	3.87E-04	<1
Stainless Steel	7.67E-01	3.5
Steel	1.36E+00	6.2
White bronze	2.52E+00	11.4
Zinc, die cast	2.88E-02	<1

Note: Glazing is excluded from this study.





# ENVIRONMENTAL PRODUCT DECLARATION



YKK AP America  
Aluminum Window Systems

According to ISO 14025

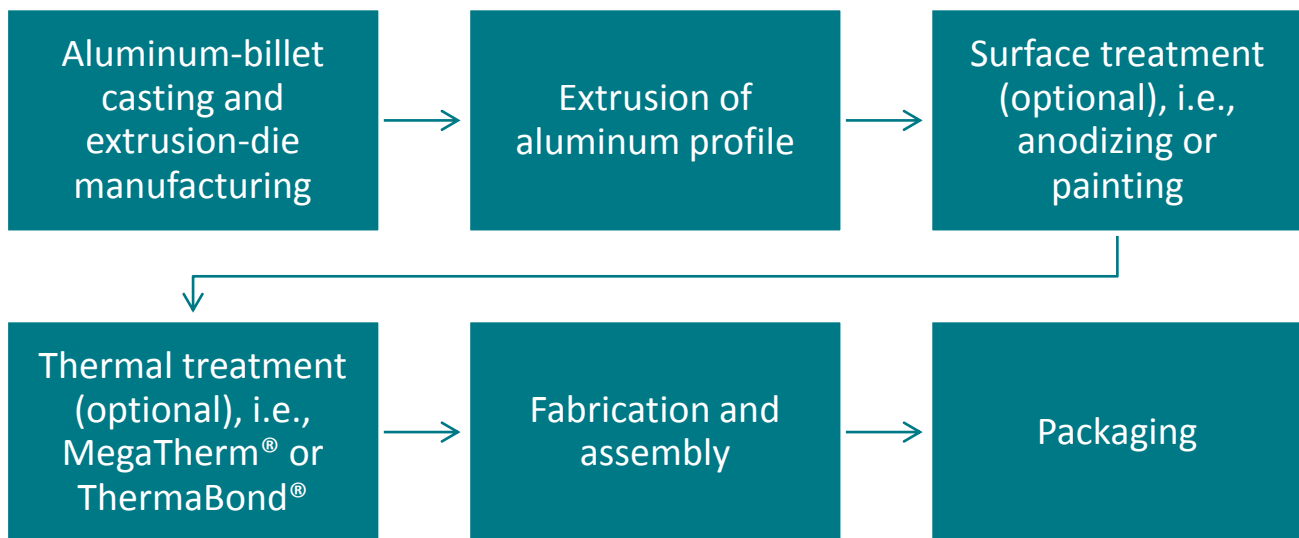
## Delivery Status

YKK AP® windows vary in size depending on the application. This includes zero-sightline windows that may be installed in most YKK AP storefronts, window wall or curtain wall systems. Windows with the ProTek® hurricane and blast mitigating designation are designed to protect buildings from the impacts of hurricanes and man-made disasters. Commercial windows with the enerGfacade® energy saving solution designation utilize YKK AP's MegaTherm® thermal barrier technology to deliver up to 30% greater energy efficiency than traditional thermally broken systems. YKK AP commercial windows accept a variety of glazing options, spacers and gas fills for even greater efficiency and occupant comfort.

## Manufacturing

All YKK AP® products are manufactured, finished and inspected for quality in our environmentally certified, state-of-the-art facility in Dublin, GA.

The manufacturing process comprises the following production stages:



The main material input into the YKK AP manufacturing process is aluminum ingot, which is first alloyed to the desired grade and cast into billets. Subsequently, the billets are extruded into profiles using steel dies that are manufactured on-site. The extruded profiles may then be anodized or painted. Optional thermal treatment, whereby a system is thermally broken, leads into the product's fabrication and assembly. The complete assemblies are packed for shipment.

## Packaging

YKK AP® products are primarily packaged using corrugated cardboard and wood components prior to shipping to installation sites.

## Product Processing/Installation and Reference Service Life, Condition of Use

The installation and use stages are outside of the scope of this EPD.



# ENVIRONMENTAL PRODUCT DECLARATION



YKK AP America  
Aluminum Window Systems

According to ISO 14025

## End of Life: Recycling and Disposal (C4)

Name	Value	Unit
Recycling	1.40E+01	kg
Landfilling (non-recycled Aluminum, other materials)	8.02E+00	kg

Aluminum extrusions are a highly efficient sustainable building material. Aluminum is 100% recyclable and can be recycled repeatedly. Recycled aluminum is identical to smelted aluminum but requires only 1/20 of the energy to manufacture. In building and construction aluminum scrap has a recycling rate of 95% [AA, 2013]. The remaining 5% is sent to landfill.

AA. (2013). *The Environmental Footprint of Semi-finished Aluminum Products in North America: A Life Cycle Assessment Report*. Aluminum Association.

## Environment and Health

**Product manufacturing:** Plant emissions to air/soil/water are monitored (if applicable) and comply with local laws.

**Product use:** YKK AP products are not expected to create exposure conditions that exceed safe thresholds for health impacts to humans or flora/fauna under normal operating conditions. Use stage is outside of the scope of this EPD.



# ENVIRONMENTAL PRODUCT DECLARATION



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Aluminum Window Systems

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## Life Cycle Assessment – Product System and Modeling

A “cradle-to-gate with options” analysis using life cycle assessment (LCA) techniques was conducted for this EPD. The analysis was done according to the product category rule (PCR) for Windows and Doors published by the German Institute Construction and Environment (IBU) and followed LCA principles, requirements and guidelines laid out in the ISO 14040/14044 standards. As such, EPDs of construction products may not be comparable if they do not comply with the same PCR. While the intent of the PCR is to increase comparability, there may still be differences among EPDs that comply with the same PCR (e.g., due to differences in system boundaries, background data, etc.).

### Declared Unit

The declared unit specified by the PCR is one window measuring 1.23 m x 1.48 m. Frame-percentage range is based on NRFC 100 test specimen sizes and configurations.

Name	Value	Unit
Declared unit	1	Reference window 1.23 m x 1.48 m
Conversion factor to 1 kg	1/22.0	-
Frame percentage $A_{frame} / A_{window}$	12 – 47	%

### System Boundaries

Per the PCR, this “cradle-to-gate with options” analysis provides information on the Product Stage of the aluminum product life cycle, comprising modules A1–A3, and on the “options” Disposal and Credits, i.e., modules C4 and D:

DESCRIPTION OF THE SYSTEM BOUNDARY (X = INCLUDED IN LCA; MND = MODULE NOT DECLARED)																
PRODUCT STAGE			CONSTRUCTION PROCESS STAGE		USE STAGE							END OF LIFE STAGE			BENEFITS AND LOADS BEYOND THE SYSTEM BOUNDARIES	
Raw material supply	Transport	Manufacturing	Transport	Construction-in-stallation process	Use	Maintenance	Repair	Replacement <sup>1</sup>	Refurbishment <sup>1</sup>	Operational energy use	Operational water use	De-construction demolition	Transport	Waste processing	Disposal	Reuse-Recovery-Recycling-potential
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
X	X	X	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	X	X

**Time coverage:** Primary data were collected on production within calendar year 2014. Background data for upstream and downstream processes (i.e., raw materials, energy resources, transportation and ancillary materials) were obtained from the GaBi 2014 databases.

**Technology coverage:** Data were collected for the production of aluminum window products at YKK AP’s manufacturing facility in the United States.

**Geographical coverage:** All YKK AP® products are manufactured in Dublin, Georgia, USA. As such, the geographical coverage for this study is based on United States system boundaries for all processes and products. Whenever US background data were not readily available, European data or global data were used as proxies.



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## Assumptions

This study was performed based on primary YKK AP data for the production of an average window system. However, up to fabrication and assembly, where a bill of materials (BoM) specifies the parts which comprise an individual product, the underlying model was created to describe YKK AP® aluminum extrusions as generic intermediates. Thus, it was assumed that the same annual average split for surface treatments—i.e., 50% anodized, 18% painted, 32% remain mill finish—apply to extrusions going into window products as well as extrusions going into other products, e.g., entrances (see separate EPD).

Another assumption was made in accounting for packaging materials, i.e., wood and corrugated cardboard. Due to a lack of data granularity, which is, at least partially, owed to the realities on the factory floor, packaging materials were scaled with the aluminum content as identified in the BoM.

Beyond that, no significant assumptions have been made. All of the raw materials and energy inputs were modeled using processes and flows that closely follow actual production raw materials and processes. All of the material and energy flows have been accounted.

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## Allocation

No multi-output (i.e., co-product) allocation was performed in this study. Allocation of background data (energy and materials) taken from the GaBi 2014 databases is documented online at <http://www.gabi-software.com/support/gabi/gabi-6-lci-documentation/>.

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## Cut-off Criteria

As required by EN 15804, in case of insufficient input data or data gaps for a unit process, the cut-off criteria were 1% of renewable and non-renewable primary energy usage and 1% of the total mass input of that unit process. The total of neglected input flows per module was a maximum of 5% of energy usage and mass.

In practice, all inputs and outputs for which data are available have been included in the calculation. Data gaps have been filled by conservative assumptions with average or generic data. Capital items for the production processes (machines, buildings, etc.) were not taken into consideration.

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## Background Data

In order to model the life cycle for the production and recycling of the extruded aluminum, the GaBi Professional software system developed by thinkstep AG was used. All relevant background data necessary for the production of extruded aluminum were taken from the GaBi 2014 databases.

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## LCA Practitioner

This EPD and the underlying LCA model were developed by thinkstep, Inc.



thinkstep

**Environment**





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YKK AP America  
Aluminum Window Systems

According to ISO 14025

## Life Cycle Assessment – Results and Analysis

Results given per declared unit: one window measuring 1.23 m x 1.48 m.

### ENVIRONMENTAL IMPACTS

CML 2001 (Apr 2013)

Parameter	Unit	Manufacturing	Disposal	Credits
		A1-A3	C4	D
GWP	kg CO <sub>2</sub> eq	1.89E+02	3.65E-01	-1.07E+02
ODP	kg CFC-11 eq	3.65E-07	8.36E-12	-4.52E-09
AP	kg SO <sub>2</sub> eq	1.21E+00	1.62E-03	-7.63E-01
EP	kg PO <sub>4</sub> <sup>3-</sup> eq	6.51E-02	2.05E-04	-3.16E-02
POCP	kg C <sub>2</sub> H <sub>4</sub> eq	8.46E-02	1.62E-04	-3.82E-02
ADPE	kg Sb eq	1.72E-03	1.43E-07	-5.73E-05
ADPF	MJ	2.13E+03	5.67E+00	-9.83E+02

TRACI 2.1

Parameter	Unit	Manufacturing	Disposal	Credits
		A1-A3	C4	D
GWP	kg CO <sub>2</sub> eq	1.89E+02	3.65E-01	-1.07E+02
ODP	kg CFC-11 eq	3.88E-07	8.89E-12	-4.81E-09
AP	kg SO <sub>2</sub> eq	1.16E+00	1.74E-03	-7.03E-01
EP	kg N eq	2.78E-02	9.50E-05	-1.13E-02
SP	kg O <sub>3</sub> eq	1.10E+01	3.38E-02	-5.44E+00
FF	MJ	1.73E+02	7.31E-01	-6.50E+01

### RESOURCE USE

Parameter	Unit	Manufacturing	Disposal	Credits
		A1-A3	C4	D
PERE	[MJ]	8.10E+02	3.17E-01	-6.33E+02
PERM	[MJ]	-	-	-
PERT	[MJ]	8.10E+02	3.17E-01	-6.33E+02
PENRE	[MJ]	2.24E+03	5.84E+00	-1.01E+03
PENRM	[MJ]	-	-	-
PENRT	[MJ]	2.24E+03	5.84E+00	-1.01E+03
SM	[kg]	7.87E-01	-	-
RSF	[MJ]	-	-	-
NRSF	[MJ]	-	-	-
FW	[m <sup>3</sup> ]	3.58E+00	-5.41E-03	-2.76E+00

### OUTPUT FLOWS AND WASTE CATEGORIES

Parameter	Unit	Manufacturing	Disposal	Credits
		A1-A3	C4	D
HWD	[kg]	1.28E-02	1.13E-06	-1.01E-02
NHWD	[kg]	4.54E+01	8.21E+00	-3.41E+01
RWD	[kg]	4.36E-02	6.49E-05	-1.06E-02
CRU	[kg]	-	-	-
MFR	[kg]	-	1.43E+01	-
MER	[kg]	-	-	-
EEE	[MJ]	-	-	-
EET	[MJ]	-	-	-

### Glossary

#### Environmental Impacts

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
FF	Fossil fuel consumption

#### Resource Use

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
PERT	Total use of 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
PENRT	Total use of non-renewable primary energy resources
SM	Use of secondary material
RSF	Use of renewable secondary fuels
NRSF	Use of non-renewable secondary 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
CRU	Components for re-use
MFR	Materials for recycling
MER	Materials for energy recovery
EE	Exported energy per energy carrier



# ENVIRONMENTAL PRODUCT DECLARATION



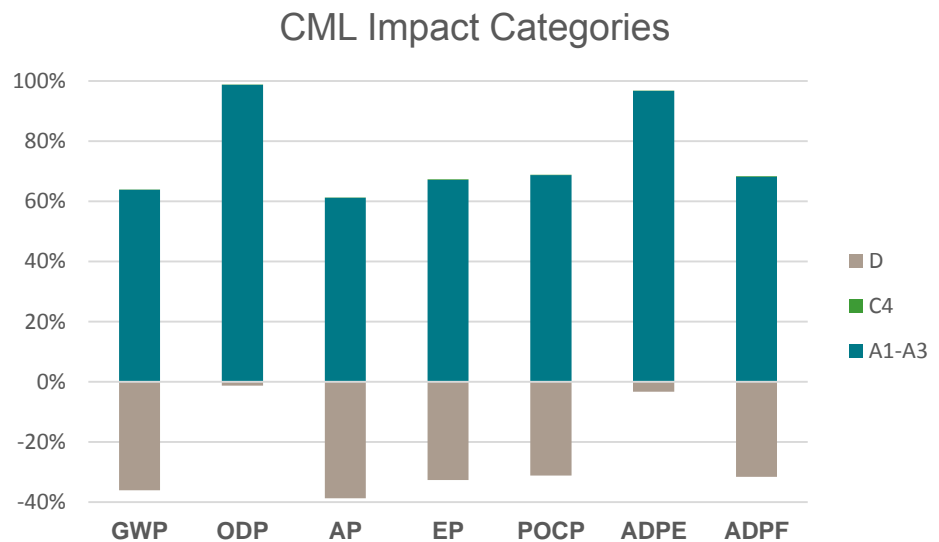
YKK AP America  
Aluminum Window Systems

According to ISO 14025

## Interpretation

The results represent the cradle-to-gate and disposal environmental performance of the evaluated window system. As shown in the figure to the right, the results indicate that the impacts are driven by the product stage (modules A1-A3). The primary impact is derived from upstream aluminum production in module A1 (raw material supply). The YKK AP manufacturing processes account for a relatively small part of the manufacturing impact in comparison.

As module D (material credit at the end of life) clearly impacts the results, it is important to note that the applied recycling rate of 95% represents a defensible rate for aluminum extrusion products in the building and transportation sector. This is based on a conservative calculation for global aluminum recycling from these sectors. If a higher rate is used, the credit will increase, thus lowering the net life-cycle impacts. Similarly, a lower recycling rate would raise the net life cycle impacts. As new information becomes available (e.g., the Aluminum Association publishes regional-specific recycling rates), this EPD should be modified to reflect the most current industry conditions.



## Data Quality Assessment

**Temporal representativeness:** All primary data were collected for the year 2014. All secondary data come from the GaBi 2014 databases and are representative of the years 2010-2013. Therefore, temporal representativeness is warranted. **Geographical representativeness:** All primary and secondary data were collected specific to the countries or regions under study. Where country-specific or region-specific data were unavailable, proxy data were used. Geographical representativeness is considered to be high. **Technological representativeness:** All primary and secondary data were modeled to be specific to the technologies or technology mixes under study. Where technology-specific data were unavailable, proxy data were used. Technological representativeness is considered to be high. **Precision:** As the majority of the relevant foreground data are measured data or calculated based on primary information sources of the owner of the technology, precision is considered to be high. All background data are sourced from GaBi databases with the documented precision.

## References

- IBU. (2014). *PCR for Building-Related Products and Services - Part A: Calculation Rules for the LCA and Requirements Project Report*, (IBU/UL E, V1.3, 06.19.2014), *Part B: Requirements on the EPD for windows and doors* (IBU, V1.7, 06.11.2014), *Part B Addendum: IBU PCR for Windows and Doors* (UL E, V1.0 Oct. 2015). Berlin: Institut Bauen, Umwelt.
- ISO. (2006). *ISO 14025: Environmental labels and declarations — Type III environmental declarations — Principles and procedures*. Geneva: International Organization for Standardization.
- EN. (2013). *EN 15804:2012-04+A1 2013: Sustainability of construction works — Environmental Product Declarations — Core rules for the product category of construction products*.

