ENVIRONMENTAL PRODUCT DECLARATION

ALUMINUM SUN CONTROL SYSTEMS

THERMASHADE® SUNSHADES

The Genzyme Bio Surgery Center in Richfield, NJ, uses YKK AP's sun control systems to manage solar heat gains to meet sustainable design goals.

YKK AP's unique sun control energy efficient devices are constructed from high quality aluminum extrusions. These devices work in concert with the façade and other building components to improve occupant comfort.

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 sun control 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.

UL CERTIFIED ENVIRONMENTAL PRODUCT DECLARATION UL.COM/EPD

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YKK AP America
Aluminum Sun Control 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	4786832322.104.1
DECLARED PRODUCT	Aluminum Sun Control Systems
REFERENCE PCR	Part A: Calculation Rules for the LCA and Requirements Project Report, (IBU/UL Environment, V1.3, 06.19.2014) and Part B Addendum: IBU PCR for Products of aluminum and aluminum alloys (UL Environment, 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 ☐ INTERNAL ☒ EXTERNAL	 Wade Stout, UL Environment
This life cycle assessment was independently verified in accordance with ISO 14044 and the reference PCR by:	 Thomas Gloria, Industrial Ecology Consultants

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Product Definition

Category Description

Sun control energy efficient devices help manage solar heat gain to meet sustainable design goals. They work in concert with the façade and other building components to improve occupant comfort by redirecting sunlight.

Sunshades have a few common characteristics. A sun control device usually has an outer frame (outrigger), an inner component (louver) and fascia components. ThermaShade® sunshades can be applied to curtain wall, storefront façades and masonry walls to maintain a consistent appearance across the building envelope.

When integrated with YKK AP's thermally broken systems, innovative anchoring methods ensure that the thermal performances of the host systems are maintained. YKK AP's patented system design provides pre-engineered solutions yielding extensive flexibility, design freedom, speed of delivery and ease of installation.

All YKK AP® products are manufactured, finished and inspected for quality in a single 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, contact your local sales representative for more information.

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® aluminum sun control systems are covered by this EPD:

ThermaShade® Sun Control System for Curtain Wall and Storefront

YKK AP's ThermaShade system is designed to improve comfort and lower energy consumption by decreasing solar heat gain. Designers now have a solution that can be applied to both curtain wall and storefront façades to maintain a consistent appearance across the building envelope. The expanded line allows designers to maintain the functional benefit of the legacy system while offering a new, industrial, design option. All systems are available in all YKK AP's standard and premium finishes. When integrated with YKK AP's thermally broken systems, innovative anchoring methods ensure that the thermal performances of the host systems are maintained. The ThermaShade system is a Cradle to Cradle Certified™ sunshade system featuring a thermal barrier within the attachment anchor. Pre-engineered solutions provide extensive flexibility for design freedom, speed of delivery and installation.

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Technical Performance

Name	Value	Unit
Density	2.69 x 10^3	(kg/m^3)
Melting Point (Typical)	615 – 655	°C
Electrical conductivity (Typical) at 20°C	53	%IACS
Thermal conductivity (Typical) at 25°C	200 – 210	W/(mK)
Average Coefficient of thermal expansion (Typical) 20°C to 100°C / 68°F to 212°F	23.4	10^{-6} per °C
Modulus of elasticity (Typical)	68.94	MPa x 10^3
Hardness (Typical)	60 – 73	HB
Yield strength (min)	103 – 172	MPa
Ultimate tensile strength (min)	145 – 207	MPa
Breaking elongation (min) (50mm & 4D)	8	%
Chemical composition	Al 97.5 – 99.35	% by mass

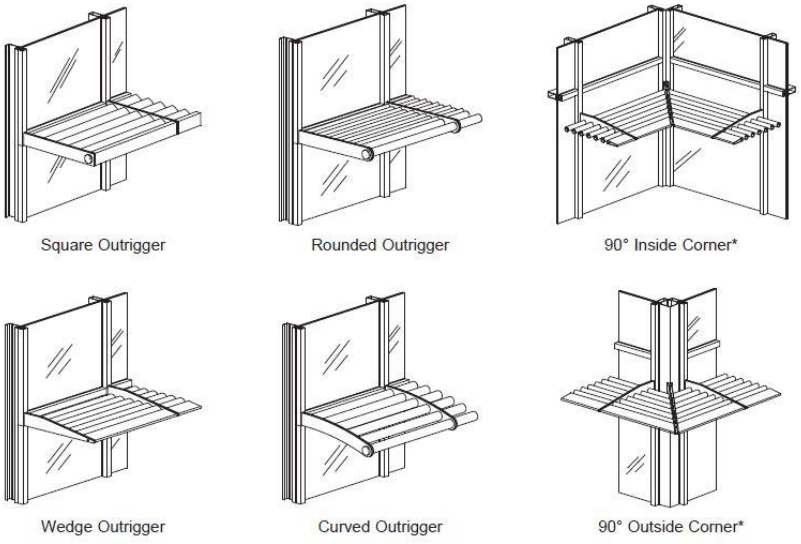
Industry Standards

ThermaShade® testing is based on material specification, as performance tests for sunshades are yet to be established. Currently, there are no available approved industry testing standards for sunshade products for performance under unforeseeable influence of fire, water of mechanical destruction; therefore, ThermaShade is not tested or rated under these extraordinary effects.

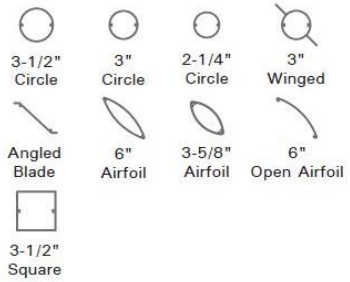
Delivery Status

YKK AP® sun control systems vary in size depending on the application. ThermaShade sunshades feature over one-hundred pre-engineered solutions, including: 24", 30" and 36" projections; four standard outrigger designs; eight standard louver options; five standard fascia options.

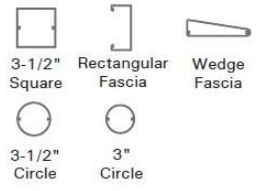
Outrigger Configurations



Available Louvers



Available Fascia



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Base and Ancillary Materials

Material	Mass [kg]	Mass [%]
Aluminum 6063	0.977 – 0.986	97.7 – 98.6
Anodizing coat, optional	0 – 5.92E-03	<1
Paint coat, optional	0 – 3.19E-03	<1
Stainless steel (purchased)	9.29E-03	<1
Aluminum (purchased)	5.16E-03	<1

Manufacturing

All YKK AP® products are manufactured, finished and inspected for quality in a single 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. The ingot is first alloyed to the desired grade and cast into billets. Subsequently, the billets are extruded into profiles using steel dies which are manufactured on-site. The extruded profiles may then be anodized or painted before being fabricated and assembled to specification. In a last step, the complete product 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

Outside of the scope of this EPD (installation stage excluded).

Reference Service Life, Condition of Use

Outside of the scope of this EPD (use stage excluded).

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End of Life: Recycling and Disposal (C4)

Name	Value	Unit
Recycling	9.42E-01	kg
Landfilling (non-recycled Aluminum, other materials)	5.80E-02	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]. 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.

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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 Products of Aluminium and Aluminium Alloys 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 for an EPD is one kilogram of extruded aluminum, i.e., one kilogram of YKK AP® sun control product, including surface treatments and ancillary components necessary for the system to fulfill its function.

Name	Value	Unit
Declared unit	1	kg
Conversion factor to 1 kg	1	-
Declared unit	n/a	m^2

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-installation process	Use	Maintenance	Repair	Replacement[1]	Refurbishment[1]	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 sun control 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 a representative ThermaShade sun control 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 sun control products as well as extrusions going into other products, e.g., windows (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.

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/.

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, were included in the calculation. Data gaps were filled by conservative assumptions with average or generic data. Capital items for the production processes (machines, buildings, etc.) were not taken into consideration.

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.

LCA Practitioner

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

thinkstep

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Life Cycle Assessment – Results and Analysis

Results given per declared unit: one kilogram of product.

ENVIRONMENTAL IMPACTS

CML 2001 (Apr 2013)

		Manufacturing	Disposal	Credits
Parameter	**Unit**	**A1-A3**	**C4**	**D**
GWP	kg CO_2 eq	8.98E+00	2.62E-03	-7.03E+00
ODP	kg CFC-11 eq	6.61E-10	6.01E-14	-2.97E-10
AP	kg SO_2 eq	6.31E-02	1.16E-05	-5.02E-02
EP	kg PO_4^3 eq	3.26E-03	1.47E-06	-2.08E-03
POCP	kg C_2H_4 eq	4.25E-03	1.17E-06	-2.51E-03
ADPE	kg Sb eq	1.47E-05	1.03E-09	-3.76E-06
ADPF	MJ	9.44E+01	4.08E-02	-6.46E+01

TRACI 2.1

		Manufacturing	Disposal	Credits
Parameter	**Unit**	**A1-A3**	**C4**	**D**
GWP	kg CO_2 eq	8.98E+00	2.62E-03	-7.03E+00
ODP	kg CFC-11 eq	7.03E-10	6.39E-14	-3.16E-10
AP	kg SO_2 eq	6.07E-02	1.25E-05	-4.62E-02
EP	kg N eq	1.33E-03	6.83E-07	-7.43E-04
SP	kg O_3 eq	5.61E-01	2.43E-04	-3.58E-01
FF	MJ	7.01E+00	5.26E-03	-4.28E+00

RESOURCE USE

		Manufacturing	Disposal	Credits
Parameter	**Unit**	**A1-A3**	**C4**	**D**
PERE	[MJ]	4.48E+01	2.28E-03	-4.16E+01
PERM	[MJ]	-	-	-
PERT	[MJ]	4.48E+01	2.28E-03	-4.16E+01
PENRE	[MJ]	9.92E+01	4.20E-02	-6.64E+01
PENRM	[MJ]	-	-	-
PENRT	[MJ]	9.92E+01	4.20E-02	-6.64E+01
SM	[kg]	5.37E-02	-	-
RSF	[MJ]	-	-	-
NRSF	[MJ]	-	-	-
FW	[m^3]	1.96E-01	-3.89E-05	-1.81E-01

OUTPUT FLOWS AND WASTE CATEGORIES

		Manufacturing	Disposal	Credits
Parameter	**Unit**	**A1-A3**	**C4**	**D**
HWD	[kg]	7.76E-04	8.10E-09	-6.64E-04
NHWD	[kg]	2.50E+00	5.90E-02	-2.24E+00
RWD	[kg]	1.94E-03	4.67E-07	-6.99E-04
CRU	[kg]	-	-	-
MFR	[kg]	-	9.42E-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

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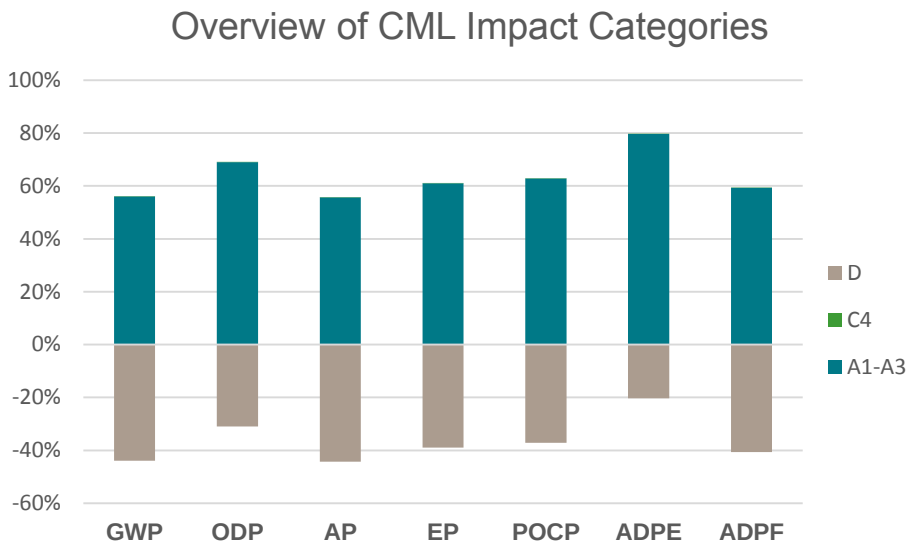
Interpretation

The results represent the cradle-to-gate and disposal environmental performance of the evaluated ThermaShade sun control 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 total life-cycle impacts. Similarly, a lower recycling rate would raise the total 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 (http://www.gabi-software.com/support/gabi/gabi-6-lci-documentation/).

References

IBU. (2014). *PCR for Building-Related Products and Services - Part A: Calculation Rules for the LCA and Requirements Project Report, (IBU/UL Environment, V1.3, 06.19.2014) and Part B Addendum: IBU PCR for Products of aluminum and aluminum alloys (UL Environment, 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*.