AGC GLASS EUROPE

ENVIRONMENTAL AND HEALTH PRODUCT DECLARATION

Matelux

Acid-etched glass

In accordance with ISO 14025:2010, EN 15804+A1:2014 and its French national complement NF EN15804/CN:2016

November 2019

1. Warning

Information from this declaration are provided under AGC Glass Europe responsibility according to the standards EN 15804+A1:2014 and the French national complement NF EN15804/CN:2016.

Any total or partial use of the information provided in this document shall at least be accompanied by an explicit reference to this EPD as well as its issuer. The latter can provide the original document upon request.

EN 15804+A1 from CEN has been used as Product Category Rules (PCR).

2. Reading guide

Environmental impacts results, resource use indicators as well as waste and output flows are presented in scientific writing with three significant digits.

All positive values (> 0) reflect environmental impacts and negative values (< 0) refer to environmental benefits. This approach applies to all modules, including module D. Where module D has a results higher than zero, it is an additional impact.

3. Comparability of EPD for construction products

Environmental product declarations may not be comparable if they do not comply with EN15804+A1.

Chapter *5.3 Comparability of EPD construction products* from EN15804+A1 norm defines the required conditions under which the construction products can be compared, on the basis of the information provided by the EPD:

A comparison of the environmental performance of construction products, based on their EPDs, shall be based on the use of the products and their impacts on the building, and shall account for the entire life cycle of the product (i.e. include all information modules).

4. General information

Name and address of the manufacturer	AGC Glass Europe Avenue Jean Monnet 4 B-1348 Louvain-la-Neuve sustainability@eu.agc.com
Production sites	This EPD is representative of Matelux range which is the acid-etched glass sold by AGC Glass Europe in France. AGC Glass Europe operates 4 production sites in Europe providing acid-etched glass to French and European market. Results from this EPD reflects data collected from all these sites, representing 100% of the production.
Type of EPD	☐ Cradle to factory gate ☐ Cradle to grave ☒ Cradle to grave + module D
	☐ Collective ☒ Individual, covering AGC Glass Europe range of products
Verifier name	Cécile Beaudard (Solinnen)
Program operator	**FDES INIES** www.inies.fr Address : Association HQE, 4 avenue du Recteur Poincaré – 75016 Paris - FRANCE
Publication date	November 2019
Expiration date	November 2024
Target audience	This EPD is primarily intended for business-to-business communication, although they might be consulted by end consumers as well (business-to-consumer).

Commercial references covered by the EPD

Reference product is a Matelux 4 mm. It is an acid-etched glass of 4 mm thickness. It is a real product representative of main market share of Matelux range of product.

This EPD also covers product of 3 mm, 5 mm thickness. These products have environmental impacts within a range of +/-40% compared to the reference product studied. The table below summarizes products covered as regards thickness.

Products	3mm	4mm	5mm	6mm	8mm	10mm	12mm	15mm	19mm
Matelux	X	**X**	X						
Matelux T	X	x	X						

Legend

X	Other references covered by this EPD
X	Reference product of this EPD
	Other references not covered by this EPD

5. Functional unit and product description

5.1. Description of the functional unit

The functional unit is to provide 1 m² of glazing offering privacy while letting light going through over 30 years.

The associated reference flow is a 1m² acid-etched glass of 4 mm thickness from Matelux range.

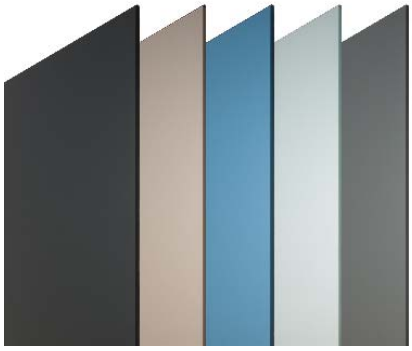
Note 1: the functional unit does not mention any performance criteria since acid etched glass is not subject to CE marking. Hence, no performance is declared for these products.

Note 2: The reference service life of the product is set to 30 years. This period does not reflect real product lifetime, which is generally defined by building refurbishment. It does not refer to product guarantee neither. This period reflects a standard duration of use considered in glazing EPDs.

5.2. Product description

The reference product is a 4 mm soda-lime glass from which one of its side has been acid-etched. Acid-etched glass has a uniform pattern, letting light going through while offering privacy.

1. Microscope view of acid-etched side



2. Products from matelux range

3. Privacy offered by Matelux

More information available on www.yourglass.com.

5.3. Description of the product usage

Acid-etched glass can be used in a wide variety of applications either for furniture (table, desk, cupboards, shower…) or for assembly in building construction products (insulating glazing units, floors, internal partitions…)

This product has a decorative function and is not covered by norms and CE marking. Main characteristics from this product are not quantifiable, especially as regards the privacy level offered.

5.4. Other technical features not included in the functional unit

Not applicable.

5.5. Description of the product main components and/or material

Acid-etched glass is made of 100% soda-lime float glass. The etched effect is the result of an acid attack of one of the float glass side.

Matelux 4 mm composition

Product composition	Matelux 4 mm
Float glass (soda-lime)	
Mass (kg)	10 kg
Mass (% final product)	100%
Packaging	
Wood (“end-caps”)	272 g/m²
Steel – nails (“end-caps)	8.5 g/m²
Steel - belts	5.84 g/m²
Cardboard	0.52 g/m²
LDPE film	2.39 g/m²
PE - belts	0.29 g/m²
PE – foam	0.23 g/m²
Aluminium – film	1.15 g/m²
Desiccant	0.67 g/m²
Interleavant powder (PMMA)	0.78 g/m²
Stillage (Steel)	30 g/m² (depreciation of reusable stillages)

5.6. Substances from REACH candidate list

Matelux product range covered by this EPD does not contain any substance from REACH candidate list according to REACH regulation (more than 0.1%)

5.7. Reference service life description

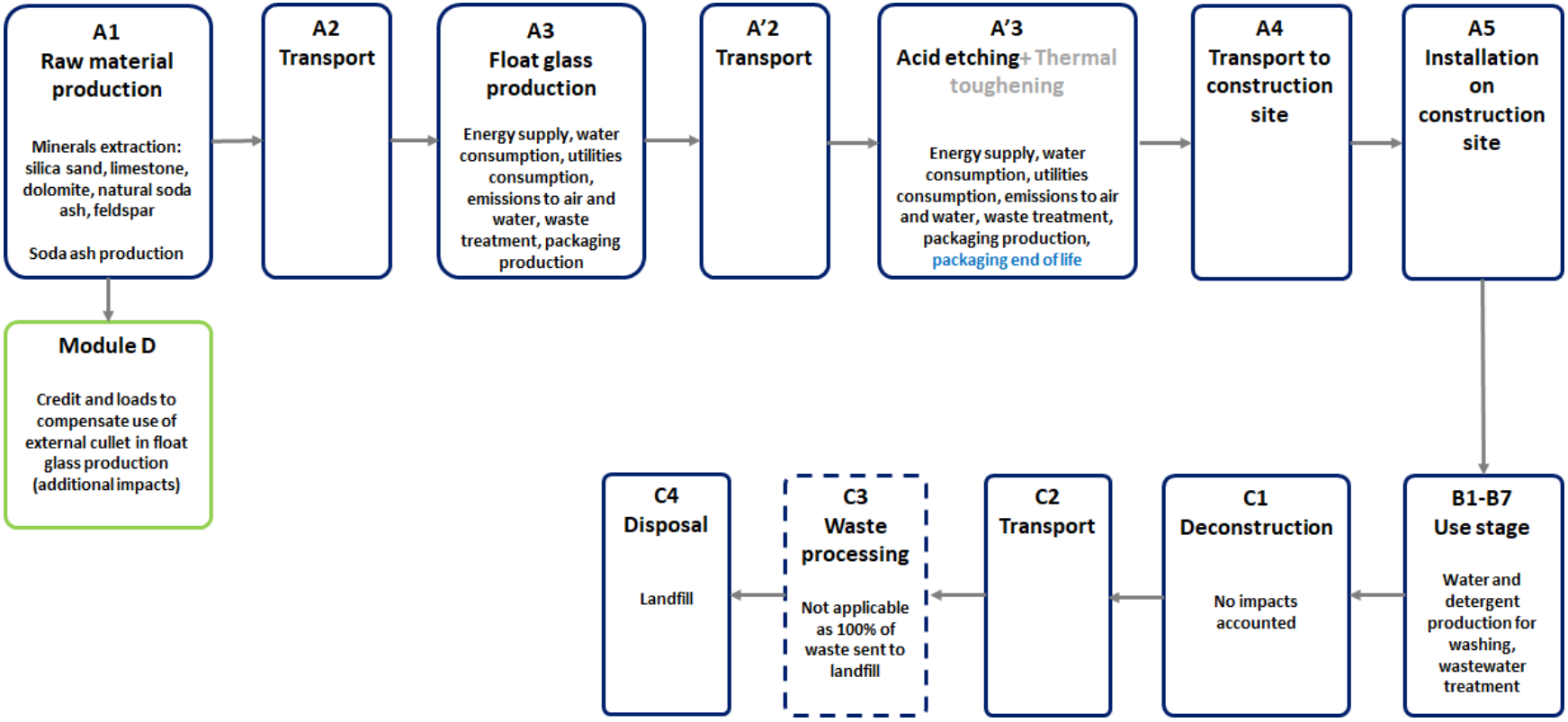
The reference service life (RSL) of acid-etched glass is 30 years.

Reference conditions of product use justifying RSL

Parameter	Value
Reference service life	30 years
Declared product properties (when leaving the production site) and finishing	No performance declared for etched glass, due to the absence of norm and CE marking.
Theoretical application parameters (if imposed by the producer), including references to the appropriate use practices	These information are detailed in the standard NF DTU 39:2006 *Building works – Glazing and Mirror Glass Works*, which defines the specifications for the implementation of glazing and installation of glazing products (new construction, renovation, refurbishment, maintenance) performed on site in all types of buildings.
Alleged quality of the construction work, when the installation is made in accordance with the manufacturer's instructions	
Exterior environment (for exterior applications), e.g. weather resistance, pollutants, UV and wind exposure, building orientation, shade, temperature	
Interior environment (for interior applications), e.g. temperature, humidity, chemicals exposure	
Use conditions, e.g. usage frequency, mechanical exposure	
Maintenance, e.g. required frequency, type and quality and replacement of replaceable components	

6. Life cycle stages

This EPD is a cradle to grave study, with module D (benefits beyond the system boundaries).
Life cycle stages regarding product installation (A5) and product use (B1-B7) are modelled based on Glass in building product category rules FprEN 17074:2019.



6.1. Production stage, module A1-A3

Module A1-A3 covers the production and transport of raw materials used for acid-etched glass production. It also covers consumptions and emissions from etching process such as energy and water consumption, water effluents, wastes treatment. It also covers production and end of life of packaging, as indicated in FprEN 17074:2019.

Acid-etched glass production process involves the following steps:

- Float glass loading
- Washing
- Protection of the non-etched side with a plastic film
- Acid etching
- Washing
- Packaging

Allocations

A1: Float glass production impacts are allocated based on mass. Impacts per m² are then derived based on float glass thickness and glass density.

A3: Consumptions and emissions form acid-etching have been allocated based on acid-etched glass area produced.

These allocation comply with the flat glass product category rule FprEN 17074:2019.

6.2. Construction stage, module A4-A5

1. **Transport to the construction site**

Transport to construction site considers an average distance of 1600 km. This value reflects the weighted average distance between AGC plants and Paris. Acid-etched glass is transported by road in diesel trucks of 24.7 tonnes net load.

Transport to construction site

Parameter	Value	Unit
Vehicle description	25	Tonne | Diesel truck - EURO 5 – cargo, 40 t gross payload
Distance to construction site	1600	km
Utilisation rate (including empty return)	50	%

Average load and utilisation rate correspond to the use of “inloaders” trucks dedicated to glass transportation. These trucks are loaded at full capacity when leaving factories but have no possibility to transport other goods than glass when traveling back. The utilisation rate of 50% reflects thus a 100% utilisation for the outbound journey and an utilisation rate of 0% for the inbound journey.

2. Installation on site

Following FprEN 17074:2019, no ancillary materials is considered for the glass to be installed and packaging end of life is accounted in module A3.

6.3. Use stage, module B1-B7

1. Description

The only module from the use stage considered is B2 “maintenance”. This stage corresponds to glass cleaning with water and detergent.

Repair (B3), replacement (B4) and refurbishment (B5) are not considered. Under normal conditions of use, acid-etched glass does not need any of these operations.

Finally, acid-etched glass does not emit any substances neither to the air nor to water during its use (B1).

2. Maintenance parameters

Following FprEN 17074:2019, the average annual water consumption is 0.2 litres per square meter of glass (i.e. 6 litres/m² over the whole life cycle) and an annual consumption of detergents of 10 g/m² (300 g/m² over the whole life cycle). The majority of this water (75%) is considered as discharged to sewer grid and further treated in a wastewater treatment plant. The remaining 25% is considered as evaporated.

Glass maintenance

Parameter (whole life cycle)	Value	Unit
Water consumption for maintenance	6	litres
Detergent consumption	300	g
Waste water discharge to WWTP	4.5	litres

6.4. End of life stage, module C1-C4

No mechanical operation is considered as regards dismantling and demolition (module C1).
End of life includes:

- C2: transport to waste treatment site ;
- C3: waste treatment ;
- C4: landfilling of demolition wastes.

End of life scenario is based on worst case scenario, considering that 100% of the acid-etched glass is sent to landfill for inert material in the end of life.

End of life scenarios

Parameter	Value	Unit
Waste glass sent to landfill	100	%
Transport to landfill (truck)	50	km
Waste glass recycled	0	%

All glass wastes are transported by diesel truck with a net payload of 22 tonnes.

6.5. Benefits and loads beyond system boundaries, module D

Benefits and loads beyond system boundaries refer to the following parameters.

1. **Additional loads due to external cullet use in module A1**

In this EPD, benefits from recycling is already accounted at production stage in module A1 through primary data. Indeed, external cullet used for float glass production limits the environmental impacts from module A1. Hence, module D only acts as a load beyond system boundaries, balancing the environmental benefits included in module A1.
If looking at the benefits from recycling formula , module D is here referring to a negative net output flow, referring to the cullet use during float glass production. Module D is thus an additional impact corresponding to the net consumption of cullet, which is not compensated during other life cycle stages.
When using the module D formula, this additional impact is calculated as

Module D additional load = MS (IV-IS)

This additional impact is calculated as:

- The additional production of batch raw materials (silica sand, soda ash, dolomite etc.).
- The energy overconsumption due to non-use of cullet. Indeed, virgin raw material requires 25% more energy than cullet to be melted.
- Increase of CO_2 emission from decarbonisation due to the substitution of cullet by carbonated raw materials (soda ash, limestone, dolomite)

NF EN15804/CN:2016 details the calculation rule of material recovery.

$$BenefNetRecycl = MSval\ (IVval - ISval) - MS\ (IV - IS)$$

With:

Symbol	Description	Value
MS_{val}	Mass of secondary material actually recovered from the mass of collected stock	0 kg/kg float glass
IV_{val}	Inventory of production of the material substituted by the recovered secondary material in the downstream system using the material	Not assessed (worst case scenario for the end of life)
IS_{val}	Inventory of production of secondary material ready for use in the downstream system from the stock	Not assessed (worst case scenario for the end of life)
MS	Mass of secondary material introduced into the product object of assessment during its manufacture	0.854 kg/kg float glass
IV	Inventory of production of the blank material used to produce the product object of assessment in the absence of material recovery of the material	See details below
IS	Inventory of production of the secondary material ready for use to produce the product objects of assessment	

IV – IS normally refers to the inventory of production of the virgin raw materials minus the production of the secondary raw material. In case of flat glass, the point of substitution, i.e. when recycled material and virgin ones have similar properties, is achieved, when the glass has been (re)melted. Indeed, next to the avoided raw material production, the use of cullet also has an influence on the melting process (lower energy consumption and no decarbonisation), as described in annex D from FprEN 17074:2019.

2. Exclusion of recycled or valorised materials from module A3

Other materials sent to recycling are coming from module A3, for which EN 15804+A1 excludes their benefits and loads calculation from module D. The following materials have thus no benefits and loads beyond system boundaries:

- Recycled plastic film from etching process
- Recycled steel from packaging (out of order stillages, nails, belts)
- Wood from end-caps

Furthermore, energy from waste incineration or electricity from landfilling is not accounted in module, since the wastes also come from module A3.

Note:
Environmental impacts reported in module D as a positive value (> 0) are additional environmental impacts to be added to the cradle to grave results. Conversely, negative values (< 0) are environmental benefits reducing the cradle to grave impacts.

7. Information regarding life cycle assessment calculation

PCR used	ISO 14025:2010 EN 15804+A1:2014 NF EN 15804/CN:2016 FprEN 17074 :2019
System boundaries	Cradle to grave, including module D
Allocations	A1: mass based A3: area based
Primary data representativeness	*Geographical representativeness* Primary data collected from the 4 sites from AGC Glass Europe producing acid-etched glass, representing 100% of the production. Distribution in France. *Time representativeness* Primary data collected refer the whole 2017 calendar year. *Technological representativeness* Primary data collected from all the AGC Glass Europe.
Background data representativeness	GaBi version 9.2.0.58 and the associated Service Pack 39 database have been used for the modelling and the calculation of this EPD. All background data have been created or updated during the last 10 years.
Cut-off criteria	All product components and packaging have been considered in the study. In case of insufficient input data, proxy have been used to estimate environmental impacts.
Variability	Results variability for the products covered by this EPD is lower than 40% for the reference indicators from NF EN 15804/CN:2016: - Global Warming Potential - Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials - Non-hazardous wastes disposed Results variability has also been assessed for other environmental indicators from EN 15804+A1 and is also lower than 40% for all of them.

8. Life cycle assessment results

Environmental impacts	Production stage	Construction stage		Use stage							End of life stage				Total life cycle	D Benefits and loads beyond system boundaries
	Total A1-A3 Production	A4 Transport	A5 Installation	B1 Usage	B2 Maintenance	B3 Reparation	B4 Replacement	B5 Refurbishment	B6 Use of energy	B7 Use of water	C1 Deconstruction	C2 Transport	C3 Waste processing	C4 Disposal		
Global warming Potential kg CO_2 eq/FU	1.34E+01	1.27E+00	0	0	3.88E-02	0	0	0	0	0	0	3.80E-02	0	1.49E-01	1.49E+01	6.12E-01
Ozone layer depletion potential kg CFC 11 eq/FU	1.32E-08	2.09E-16	0	0	2.69E-09	0	0	0	0	0	0	6.36E-18	0	8.64E-16	1.59E-08	7.53E-10
Acidification kg SO_2 eq/FU	5.64E-02	3.08E-03	0	0	2.16E-04	0	0	0	0	0	0	2.24E-04	0	8.84E-04	6.08E-02	1.15E-03
Eutrophication kg $(PO_4)^{3-}$ eq/FU	9.65E-03	7.39E-04	0	0	1.25E-04	0	0	0	0	0	0	5.63E-05	0	1.00E-04	1.07E-02	2.04E-04
Photochemical oxidant creation potential Ethene eq/FU	3.70E-03	3.11E-04	0	0	9.47E-05	0	0	0	0	0	0	1.82E-05	0	6.85E-05	4.19E-03	8.91E-05
Abiotic resource depletion - Elements kg Sb eq/FU	8.48E-06	8.99E-08	0	0	1.77E-07	0	0	0	0	0	0	2.74E-09	0	1.48E-08	8.77E-06	6.74E-08
Abiotic resource depletion - Fossil MJ/FU	1.84E+02	1.71E+01	0	0	4.28E-01	0	0	0	0	0	0	5.22E-01	0	2.08E+00	2.04E+02	6.25E+00
Abiotic resource depletion – Elements (including NF 15804/CN) kg Sb eq/FU	8.43E-06	8.94E-08	0	0	1.76E-07	0	0	0	0	0	0	2.72E-09	0	1.32E-08	8.71E-06	6.67E-08
Water pollution m^3/FU	4.81E+00	4.12E-01	0	0	1.49E-01	0	0	0	0	0	0	1.25E-02	0	2.95E-02	5.42E+00	2.77E-01
Air pollution m^3/UF	9.32E+02	5.72E+01	0	0	1.62E+01	0	0	0	0	0	0	2.40E+00	0	1.78E+01	1.03E+03	3.34E+01

Resource use	Production stage	Construction stage		Use stage							End of life stage				Total life cycle	D Benefits and loads beyond system boundaries
	Total A1-A3 Production	A4 Transport	A5 Installation	B1 Usage	B2 Maintenance	B3 Reparation	B4 Replacement	B5 Refurbishment	B6 Use of energy	B7 Use of water	C1 Deconstruction	C2 Transport	C3 Waste processing	C4 Disposal		
Renewable primary energy as energy carrier *(MJ/FU)*	9.80E+00	9.98E-01	0	0	1.33E+00	0	0	0	0	0	0	3.04E-02	0	2.73E-01	1.24E+01	1.24E-01
Renewable primary energy resources used as raw materials *(MJ/FU)*	4.59E+00	0	0	0	0	0	0	0	0	0	0	0	0	0	4.59E+00	0
Total use of renewable primary energy resources *(MJ/FU)*	1.44E+01	9.98E-01	0	0	1.33E+00	0	0	0	0	0	0	3.04E-02	0	2.73E-01	1.70E+01	1.24E-01
Non-renewable primary energy resources as energy carrier *(MJ/FU)*	1.96E+02	1.72E+01	0	0	6.58E-01	0	0	0	0	0	0	5.24E-01	0	2.16E+00	2.16E+02	6.36E+00
Non-renewable primary energy resources used as raw materials *(MJ/FU)*	1.29E-01	0	0	0	0	0	0	0	0	0	0	0	0	0	1.29E-01	0
Total use of non-renewable primary energy resources *(MJ/FU)*	1.96E+02	1.72E+01	0	0	6.58E-01	0	0	0	0	0	0	5.24E-01	0	2.16E+00	2.163E+02	6.36E+00
Use of secondary material *(kg/FU)*	9.04E-01	0	0	0	0	0	0	0	0	0	0	0	0	0	9.04E-01	0
Use of renewable secondary fuels *(MJ/FU)*	1.38E-24	0	0	0	0	0	0	0	0	0	0	0	0	0	1.38E-24	1.29E-25
Use of non-renewable secondary fuels *(MJ/FU)*	1.63E-23	0	0	0	0	0	0	0	0	0	0	0	0	0	1.63E-23	1.52E-24
Use of net fresh water *(m^3/FU)*	2.92E-02	1.69E-03	0	0	8.42E-03	0	0	0	0	0	0	5.14E-05	0	5.43E-04	3.99E-02	1.28E-03

Waste categories	Production stage	Construction stage		Use stage							End of life stage				Total life cycle	D Benefits and loads beyond system boundaries
	Total A1-A3 Production	A4 Transport	A5 Installation	B1 Usage	B2 Maintenance	B3 Reparation	B4 Replacement	B5 Refurbishment	B6 Use of energy	B7 Use of water	C1 Deconstruction	C2 Transport	C3 Waste processing	C4 Disposal		
Hazardous waste disposal *(kg/FU)*	7.36E-07	9.61E-07	0	0	8.93E-11	0	0	0	0	0	0	2.93E-08	0	3.68E-08	1.76E-06	1.63E-08
Non-hazardous waste disposal *(kg/FU)*	4.05E-01	1.40E-03	0	0	4.29E-03	0	0	0	0	0	0	4.26E-05	0	1.00E+01	1.04E+01	1.98E-02
Radioactive waste disposal *(kg/FU)*	4.32E-03	2.33E-05	0	0	3.14E-06	0	0	0	0	0	0	7.11E-07	0	2.89E-05	4.38E-03	2.72E-05

Resource use	Production stage	Construction stage		Use stage							End of life stage				Total life cycle	D Benefits and loads beyond system boundaries
	Total A1-A3 Production	A4 Transport	A5 Installation	B1 Usage	B2 Maintenance	B3 Reparation	B4 Replacement	B5 Refurbishment	B6 Use of energy	B7 Use of water	C1 Deconstruction	C2 Transport	C3 Waste processing	C4 Disposal		
Components for reuse - kg/FU	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Materials for recycling - kg/FU	6.50E-01	0	0	0	0	0	0	0	0	0	0	0	0	0	6.50E-01	0
Materials for energy recovery - kg/FU	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Exported electrical energy (MJ/FU)	2.40E-01	0	0	0	0	0	0	0	0	0	0	0	0	0	2.40E-01	0
Exported thermal energy (MJ/FU)	3.97E-01	0	0	0	0	0	0	0	0	0	0	0	0	0	3.97E-01	0
Exported energy - Process Gas (MJ/FU)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

9. Additional information

9.1. Release of hazardous substances into indoor air, soil and water during the use stage

9.1.1. Indoor air

- **VOC and formaldehyde emissions**

Not applicable.

- **Reaction to fungal and bacterial growth**

Not tested. Glass is a mineral inert material. It is not by itself a medium for micro-organisms growth.

- **Natural radioactive emissions from construction products**

Not tested.

- **Emission of particulates and fibres emissions**

Not tested.

9.1.2. Water and soil

Not tested. The product is not in contact with water intended for human consumption.

9.2. Product contribution to indoor wellbeing

9.2.1. Product characteristics regarding hygrothermal comfort

The relevant technical characteristics for a Matelux 4mm are given in the table below.

Hygrothermal proprties

Properties	Symbol	Value
Thermal transmission (according to EN 673)	U_g (W/m².K)	5.8
Solar factor (EN 410)	g (%)	36 to 90

Source: AGC Glass Europe Glass configurator
https://www.agc-yourglass.com/configurator/en

9.2.2. Product characteristics regarding acoustics

A 4 mm acid etched glass has similar acoustic properties to a 4 mm float glass. The relevant parameter to assess it is the direct airborne sound insulation R_w (C; C_{tr}) = 30 (-2 ; -4) dB.

Source: AGC Glass Europe Glass configurator
https://www.agc-yourglass.com/configurator/en

9.2.3. Product characteristics regarding visual comfort

Being part of the building envelope, glass contributes to visual comfort by providing natural light and reducing artificial lighting needs. The light transmission value of a 4 mm Matelux is between 18% and 91% depending float glass tint.

Source: AGC Glass Europe Glass configurator
https://www.agc-yourglass.com/configurator/en

9.2.4. Product characteristics as regarding odours

Not tested. Glass is a mineral inert material, not able to release any odour during its use.

10. Extrapolation rules

Matelux products not covered by this EPD (3 mm to 19 mm) can be assessed by using extrapolation rules. These rules are applicable for any product from Matelux range.

The intended use of these extrapolation rules is to allow industrial customers using Matelux products to assess the environmental impacts of a specific product bought.

The upper and lower range are described below.

Extrapolation rules min and max products

Product composition	Matelux 3 mm	Matelux T 19 mm
Float glass		
Thickness	3 mm	19 mm
Mass (kg)	7.5 kg	47.5 kg
Toughened	No	yes
Packaging		
Wood (« end-caps »)	272 g/m²	
Steel - nails (« end-caps »)	8,5 g/m²	
Steel - belts	5,84 g/m²	
Cardboard	0,52 g/m²	
LDPE film	2,39 g/m²	
PE - belts	0,29 g/m²	
PE – foam bloc	0,23 g/m²	
Aluminium – film	1,15 g/m²	
Desiccant	0,67 g/m²	
Interleaving powder	0,78 g/m²	
Reusable steel stillage (depreciation)	30 g/m²	

Environmental impacts of Matelux products depend on the combination of three parameters:

- A fix impact
- An impact proportional to the float thickness
- An impact linked to an eventual thermal toughening

The environmental impacts are thus:

$$Env = \underbrace{I_{etching}}_{\text{Impacts from etching}} + \underbrace{(FT * I_{1mm\ float})}_{\text{Impacts from float}} + \underbrace{TG * (I_{toughening\ fix} + FT * I_{toughening\ variable})}_{\text{Impacts from toughening}}$$

With:

Env	Environmental impacts of a specific Matelux thickness
$I_{etching}$	Fix impacts from etching process
FT	Float thickness (in mm)
$I_{1mm\ float}$	Impacts per mm of float glass
TG	Boolean linked to thermal toughening (1 if toughened 0 otherwise)
$I_{toughening\ fix}$	Fix impacts from thermal toughening
$I_{toughening\ variable}$	Impacts from thermal toughening proportional to float thickness

For example, in case of a 8 mm acid-etched glass thermally toughened, environmental impacts will be calculated as:

$$Env = I_{etching} + (8 * I_{1mm\ float}) + 1 * (I_{toughening\ fix} + 8 * I_{toughening\ vriable})$$

Environmental impacts $I_{etching}$, $I_{1mm\ float}$, $I_{toughening\ fix}$ and $I_{toughening\ variable}$ are presented in the next tables. Note that only modules to which acid-etched glass contributes are presented. All other modules are considered as null (A5,B1, B3, B4, B5, B6, B7, C1).

Environmental impacts		Production stage	Construction stage	Use stage	End of life stage		Total life cycle	Module D Benefits and loads beyond system boundaries
		Total A1-A3 Production	A4 Transport	B2 Maintenance	C2 Transport	C4 Disposal		
Global Warming Potential kg CO_2 eq/FU	$I_{etching}$	1.30E+00	3.49E-02	3.88E-02	0	-4.44E-16	1.37E+00	2.00E-15
	$I_{1mm\ float}$	3.04E+00	3.08E-01	0	9.51E-03	3.72E-02	3.39E+00	1.53E-01
	$I_{toughening\ fix}$	1.50E+00	0	0	0	0	1.50E+00	0
	$I_{toughening\ variable}$	5.17E-02	0	0	0	0	5.17E-02	0
Ozone layer Depletion Potential kg CFC 11 eq/FU	$I_{etching}$	3.38E-09	5.74E-18	2.69E-09	0	0	6.07E-09	0
	$I_{1mm\ float}$	2.45E-09	5.08E-17	0	1.59E-18	2.16E-16	2.45E-09	1.88E-10
	$I_{toughening\ fix}$	4.03E-14	0	0	0	0	4.03E-14	0
	$I_{toughening\ variable}$	1.39E-15	0	0	0	0	1.39E-15	0
Acidification kg SO_2 eq/FU	$I_{etching}$	5.43E-03	8.46E-05	2.16E-04	0	0	5.73E-03	0
	$I_{1mm\ float}$	1.27E-02	7.49E-04	0	5.6E-05	2.21E-04	1.38E-02	2.87E-04
	$I_{toughening\ fix}$	3.76E-03	0	0	0	0	3.76E-03	0
	$I_{toughening\ variable}$	1.30E-04	0	0	0	0	1.30E-04	0
Eutrophication kg $(PO_4)^{3-}$ eq/FU	$I_{etching}$	2.15E-03	2.03E-05	1.25E-04	0	0	2.29E-03	0
	$I_{1mm\ float}$	1.87E-03	1.80E-04	0	1.41E-05	2.5E-05	2.09E-03	5.09E-05
	$I_{toughening\ fix}$	3.76E-04	0	0	0	0	3.76E-04	0
	$I_{toughening\ variable}$	1.30E-05	0	0	0	0	1.30E-05	0
Photochemical Oxidant Creation Potential Ethene eq/FU	$I_{etching}$	4.08E-04	8.54E-06	9.47E-05	-2.5E-19	0	5.11E-04	0
	$I_{1mm\ float}$	8.24E-04	7.56E-05	0	4.55E-06	1.71E-05	9.21E-04	2.23E-05
	$I_{toughening\ fix}$	2.65E-04	0	0	0	0	2.65E-04	0
	$I_{toughening\ variable}$	9.13E-06	0	0	0	0	9.13E-06	0

Environmental impacts		Production stage	Construction stage	Use stage	End of life stage		Total life cycle	Module D Benefits and loads beyond system boundaries
		Total A1-A3 Production	A4 Transport	B2 Maintenance	C2 Transport	C4 Disposal		
Abiotic resource depletion - Elements kg Sb eq/FU	$I_{etching}$	1.88E-07	2.47E-09	1.77E-07	0	0	3.67E-07	0
	$I_{1mm\ float}$	2.07E-06	2.19E-08	0	6.84E-10	3.7E-09	2.10E-06	1.69E-08
	$I_{toughening\ fix}$	4.29E-07	0	0	0	0	4.29E-07	0
	$I_{toughening\ variable}$	1.48E-08	0	0	0	0	1.48E-08	0
Abiotic resource depletion – Elements – French EN15804/CN kg Sb eq/FU	$I_{etching}$	1.48E-07	2.46E-09	1.76E-07	0	0	3.26E-07	0
	$I_{1mm\ float}$	2.07E-06	2.17E-08	0	6.8E-10	3.29E-09	2.10E-06	1.67E-08
	$I_{toughening\ fix}$	2.48E-07	0	0	0	0	2.48E-07	0
	$I_{toughening\ variable}$	1.47E-08	0	0	0	0	1.47E-08	0
Abiotic resource depletion - Fossil MJ/UF	$I_{etching}$	1.93E+01	4.71E-01	4.28E-01	0	0	2.02E+01	0
	$I_{1mm\ float}$	4.12E+01	4.17E+00	0	1.30E-01	5.21E-01	4.61E+01	1.56E+00
	$I_{toughening\ fix}$	1.65E+01	0	0	0	0	1.65E+01	0
	$I_{toughening\ variable}$	5.69E-01	0	0	0	0	5.69E-01	0
Water pollution – French EN15804/CN m^3/UF	$I_{etching}$	1.21E+00	1.13E-02	1.49E-01	0	0	1.37E+00	0
	$I_{1mm\ float}$	9.00E-01	1.00E-01	0	3.13E-03	7.38E-03	1.01E+00	6.92E-02
	$I_{toughening\ fix}$	3.72E-01	0	0	0	0	3.72E-01	0
	$I_{toughening\ variable}$	1.28E-02	0	0	0	0	1.28E-02	0
Air pollution – French EN15804/CN m^3/UF	$I_{etching}$	1.82E+02	2.04E+00	1.66E+01	0	0	2.01E+02	0
	$I_{1mm\ float}$	2.34E+02	1.81E+01	0	7.31E-01	4.97E+00	2.57E+02	9.92E+00
	$I_{toughening\ fix}$	9.56E+01	0	0	0	0	9.56E+01	0
	$I_{toughening\ variable}$	3.30E+00	0	0	0	0	3.30E+00	0

Resource use		Production stage	Construction stage	Use stage	End of life stage		Total life cycle	Module D Benefits and loads beyond system boundaries
		Total A1-A3 Production	A4 Transport	B2 Maintenance	C2 Transport	C4 Disposal		
Renewable primary energy as energy carrier *(MJ/FU)*	$I_{etching}$	3.49E+00	2.74E-02	1.33E+00	0	0	4.85E+00	0
	$I_{1mm\ float}$	1.58E+00	2.43E-01	0	7.59E-03	6.83E-02	1.90E+00	3.10E-02
	$I_{toughening\ fix}$	1.05E+01	0	0	0	0	1.05E+01	0
	$I_{toughening\ variable}$	3.61E-01	0	0	0	0	3.61E-01	0
Renewable primary energy resources used as raw materials *(MJ/FU)*	$I_{etching}$	4.59E+00	0	0	0	0	4.59E+00	0
	$I_{1mm\ float}$	0	0	0	0	0	0	0
	$I_{toughening\ fix}$	0	0	0	0	0	0	0
	$I_{toughening\ variable}$	0	0	0	0	0	0	0
Total use of renewable primary energy resources *(MJ/FU)*	$I_{etching}$	8.08E+00	2.74E-02	1.33E+00	0	0	9.44E+00	0
	$I_{1mm\ float}$	1.58E+00	2.43E-01	0	7.59E-03	6.83E-02	1.90E+00	3.10E-02
	$I_{toughening\ fix}$	1.05E+01	0	0	0	0	1.05E+01	0
	$I_{toughening\ variable}$	3.61E-01	0	0	0	0	3.61E-01	0
Non-renewable primary energy resources as energy carrier *(MJ/FU)*	$I_{etching}$	2.25E+01	4.73E-01	6.58E-01	0	0	2.36E+01	0
	$I_{1mm\ float}$	4.33E+01	4.18E+00	0	1.31E-01	5.39E-01	4.81E+01	1.59E+00
	$I_{toughening\ fix}$	2.71E+01	0	0	0	0	2.71E+01	0
	$I_{toughening\ variable}$	9.33E-01	0	0	0	0	9.33E-01	0
Non-renewable primary energy resources used as raw materials *(MJ/FU)*	$I_{etching}$	1.29E-01	0	0	0	0	1.29E-01	0
	$I_{1mm\ float}$	0	0	0	0	0	0	0
	$I_{toughening\ fix}$	0	0	0	0	0	0	0
	$I_{toughening\ variable}$	0	0	0	0	0	0	0

Resource use		Production stage	Construction stage	Use stage	End of life stage		Total life cycle	Module D Benefits and loads beyond system boundaries
		Total A1-A3 Production	A4 Transport	B2 Maintenance	C2 Transport	C4 Disposal		
Total use of non-renewable primary energy resources *(MJ/FU)*	$I_{etching}$	2.26E+01	4.73E-01	6.58E-01	0	0	2.37E+01	0
	$I_{1mm\ float}$	4.33E+01	4.18E+00	0	1.31E-01	5.39E-01	4.81E+01	1.59E+00
	$I_{toughening\ fix}$	2.71E+01	0	0	0	0	2.71E+01	0
	$I_{toughening\ variable}$	9.33E-01	0	0	0	0	9.33E-01	0
Use of secondary material *(kg/FU)*	$I_{etching}$	6.82E-05	0	0	0	0	6.82E-05	0
	$I_{1mm\ float}$	2.26E-01	0	0	0	0	0.225996	0
	$I_{toughening\ fix}$	0	0	0	0	0	0	0
	$I_{toughening\ variable}$	0	0	0	0	0	0	0
Use of renewable secondary fuels *(MJ/FU)*	$I_{etching}$	0	0	0	0	0	0	0
	$I_{1mm\ float}$	3.46E-25	0	0	0	0	3.46E-25	3.23E-26
	$I_{toughening\ fix}$	0	0	0	0	0	0	0
	$I_{toughening\ variable}$	0	0	0	0	0	0	0
Use of non-renewable secondary fuels *(MJ/FU)*	$I_{etching}$	-5.29E-38	0	0	0	0	-5.3E-38	0
	$I_{1mm\ float}$	4.07E-24	0	0	0	0	4.07E-24	3.8E-25
	$I_{toughening\ fix}$	0	0	0	0	0	0	0
	$I_{toughening\ variable}$	0	0	0	0	0	0	0
Use of net fresh water *(m^3/FU)*	$I_{etching}$	8.07E-03	4.64E-05	8.42E-03	-1.71E-18	6.51E-17	1.65E-02	0
	$I_{1mm\ float}$	5.29E-03	4.10E-04	0	1.28E-05	1.36E-04	5.85E-03	3.20E-04
	$I_{toughening\ fix}$	1.23E-02	0	0	0	0	1.23E-02	0
	$I_{toughening\ variable}$	4.26E-04	0	0	0	0	4.26E-04	0

As regards output flows, CFR and EEP indicators are not presented as all the modules have a null contribution for these two indicators.

Waste categories and Output flows		Production stage	Construction stage	Use stage	End of life stage		Total life cycle	Module D Benefits and loads beyond system boundaries
		Total A1-A3 Production	A4 Transport	B2 Maintenance	C2 Transport	C4 Disposal		
Waste categories								
Hazardous waste disposal *(kg/FU)*	$I_{etching}$	2.13E-07	2.64E-08	8.93E-11	0	-2.5E-22	2.39E-07	0
	$I_{1mm\ float}$	1.31E-07	2.34E-07	0	7.31E-09	9.19E-09	3.81E-07	4.07E-09
	$I_{toughening\ fix}$	1.28E-08	0	0	0	0	1.28E-08	0
	$I_{toughening\ variable}$	4.41E-10	0	0	0	0	4.41E-10	0
Non-hazardous waste disposal *(kg/FU)*	$I_{etching}$	1.66E-01	3.84E-05	4.29E-03	0	0	1.70E-01	0
	$I_{1mm\ float}$	5.98E-02	3.40E-04	0	1.06E-05	2.50E+00	2.56E+00	4.95E-03
	$I_{toughening\ fix}$	1.91E-02	0	0	0	0	1.91E-02	0
	$I_{toughening\ variable}$	6.58E-04	0	0	0	0	6.58E-04	0
Radioactive waste disposal *(kg/FU)*	$I_{etching}$	1.29E-03	6.42E-07	3.14E-06	0	0	1.29E-03	0
	$I_{1mm\ float}$	7.58E-04	5.68E-06	0.00E+00	1.78E-07	7.23E-06	7.71E-04	6.81E-06
	$I_{toughening\ fix}$	4.19E-03	0	0	0	0	4.19E-03	0
	$I_{toughening\ variable}$	1.45E-04	0	0	0	0	1.45E-04	0
Output flows								
Material for recycling *(kg/FU)*	$I_{etching}$	2.28E-01	0	0	0	0	2.28E-01	0
	$I_{1mm\ float}$	1.05E-01	0	0	0	0	1.05E-01	0
	$I_{toughening\ fix}$	0	0	0	0	0	0	0
	$I_{toughening\ variable}$	0	0	0	0	0	0	0
Exported electrical energy *(MJ/FU)*	$I_{etching}$	2.40E-01	0	0	0	0	2.40E-01	0
	$I_{1mm\ float}$	0	0	0	0	0	0	0
	$I_{toughening\ fix}$	0	0	0	0	0	0	0
	$I_{toughening\ variable}$	0	0	0	0	0	0	0
Exported thermal energy *(MJ/FU)*	$I_{etching}$	3.97E-01	0	0	0	0	3.97E-01	0
	$I_{1mm\ float}$	0	0	0	0	0	0	0
	$I_{toughening\ fix}$	0	0	0	0	0	0	0
	$I_{toughening\ variable}$	0	0	0	0	0	0	0

Matelux environmental product declaration
in accordance with ISO 14025 and EN 15804+A1

More information available on www.yourglass.com

And in the « Sustainability » section of our environmental website www.agc-glass.eu/en/sustainability