MIROX NGE

MIRROR NEW GENERATION ECOLOGICAL

the range of mirrors

AGC GLASS EUROPE
AGC INTERPANE

Reference thickness:

4 mm

Other thicknesses:

3 – 8 mm

also included safety back protection for

MNGE Lead Free
MNGE SAFE
MNGE SAFE +

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DECLARATION HOLDER

THIS DECLARATION IS BASED ON

Product Category Rules EN 15804:2012+A1:2013: Sustainability of construction works - Environmental product declarations - Core rules for the product category of construction products.

Fiche de Déclaration Environnementale et Sanitaire no. 01-534:2016.

VALIDITY DATE

This EPD applies to the above-mentioned construction product and is valid until replaced by a new version (evaluation typically 5 years from the date of issue).

DATE OF ISSUE

2016

CONSTRUCTION PRODUCT

Mirox NGE (MNGE)
Mirox NGE SAFE (MNGE SAFE)
Mirox NGE SAFE + (MNGE SAFE+)
Mirox NGE Lead Free (MNGE LF SAFE/SAFE+)

DECLARED PRODUCT / DECLARED UNIT

The declared unit is 1 m² of silver-coated float glass.

SCOPE OF VALIDITY:

The Life Cycle Assessment was carried out according to ISO 14040 and ISO 14044. The Environmental Product Declaration was prepared according to EN 15804+A1 and ISO 14025.

This document applies for products supplied from both AGC Glass Europe and AGC Interpane.

VERIFICATION

The original Environmental Product Declaration* has been audited and externally verified according to EN 15804:2012+A1:2013, NF EN 15804/CN and ISO 14025:2010 by an independent third party.

CEN standard EN 15804 serves as the core PCR
Independent verification of the declaration, according to EN ISO 14025:201 ☐ Internal ☒ External
Third Party Verifier: bio by Deloitte. (Yannick Le Guern)
* PCR : Product category rules

* The original document is available under the French Programme INIES:

Environmental and health reference data for building

PRODUCT

1.1. Product description

The product considered for the assessment is flat glass covered with a silver coating. Mirox MNGE is one of the brand name for mirrors, highly prized for their aesthetics and advances in resistance, processing and performance. This new generation of ecological mirrors stands out for its copper-free metal coating, the use of very low-level lead paints while still highly resistant to corrosion. AGC silver coated mirrors can also be delivered safety backed with a SAFE/SAFE+ film.

Reference: a *4 mm mirror, silver coated on one side of the flat glass.*

Other structures considered in this EPD: 3, 6, 8.

This glass range is treated with a silver coating. Conventional mirrors are produced by applying several layers on the glass:

- coating of silver;
- coating of copper;
- a first coating of paint containing lead, for chemical protection;
- a second coating of paint for mechanical protection;

The conventional application of both copper and lead may imply some environmental challenges.

AGC Glass Europe Group *Mirror New Generation Ecological* (MNGE) is a new development that allows the production of mirror without a copper layer and nearly without lead in the paint. Besides improved mirror qualities and their ability to resist chemical damage, the MNGE proves to reduce both the pollution caused during manufacturing and transformation (e.g. bevelling, grinding) as well as improving the possibilities to recycle the product at the end of its life. The patented manufacturing process ensures that MNGE is a high-quality, highly resistant mirror that easily exceeds the most stringent quality and resistance standards. The optionally-added safety is a transparent, colourless polypropylene film applied to the back of the mirrors (painted side) using an industrial process. If accidentally broken, the glass splinters adhere to the plastic film. Two key benefits: guaranteed safety glass and protected from scratching when the back of the mirror is exposed.

1.2. Application & delivery status

Internal use only. Mirrors are delivered in a wide variety of dimensions, applicable in all kinds of configurations. Mirrors are widespread in all fields: construction , decoration , solar panels, etc. Nowadays, they have become indispensable.

1.3. Technical Data

The application of the surface finish does not affect the thermal durability of the substrate. Matelux has the same resistance to thermal shock as that of its substrate.

Additional data on: www.yourglass.com

1.4. Relevant Product Standard

The product complies with European Standard EN 1036: Glass in building – Mirror from silver coated float glass for internal use.

1.5. Base materials / Ancillary materials

The production of flat glass substrate is also in accordant with EN 572-1 for building products that defines the magnitude of the proportions by mass of the principal constituents of float glass.

Basic raw materials used in flat glass production:

- glass forming materials: silica sand and external glass cullet;
- intermediate and modifying materials such as sodium carbonate, dolomite, limestone, feldspar & blast furnace slag, sodium sulphate;
- colouring and coating agents such as iron oxide and other metallic compounds.

Composition of the declared unit (% of total mass):

- > 98% glass;
- < 2% silvering - protection materials;

No substances of the “Candidate List of Substances of Very High Concern for Authorisation (or SVHC)”, exceeding the concentration in article threshold, in the declared unit.

1.6. Manufacturing & Processing

The basic principle of the float glass process is to mix the raw materials, melt them in the furnace and pour the molten glass onto a bath of molten tin. The combustion in the furnace uses air and gas/fuel oil. The glass solidifies as it floats on the tin bath. After the bath, the glass ribbon passes on to an annealing zone where it cools down gradually while being carried on rollers. At the end of this zone the glass is cut into sheets.

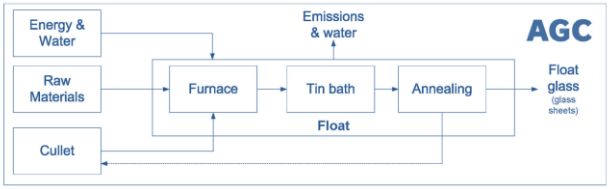


Figure 1 – Flat glass manufacturing

The process of manufacturing mirrors is called silvering glass, to which a silver-coating is applied to a flat glass sheet substrate to create the mirror-reflection. This silver-coating is then protected by a paint – which becomes the back side of the mirror product. The glass substrate undergoes 5 main process-stages: cleaning/rinsing, silvering, chemical protection, mechanical protection and a final cleaning. The main stage of the production is the silvering process is divided in smaller steps: sensibilization - activation of the substrate, coat of silver compound which provide the reflexion and finally a passivation – protection step. The main activation treatment to affix the silver coating to the glass and the passivation step protects the silver coating against oxidation. After the annealing of metal coatings and drying, the glass sheet undergoes different paint curtains followed by a baking step through an online oven. The final step is cleaning the glass sheet and finishing up by cutting and packaging. For some products a safety film can be applied. This operation does not occur on the line and the glass needs to be moved to another machine on site.

Concerning the inventory management, input data were

gathered from fifteen European based AGC float lines and five European based AGC mirror lines with the technical support of the European AGC R&D centre.

All manufacturing sites operate under a certified quality, environmental and safety management system.

1.7. Environmental and health during manufacturing

AGC plant managers are committed to the group environmental and safety policy. At group or division level specific programmes are defined to act as guidelines for the country organisations and plants. Key performance indicators (KPI's) have been selected, are reported and are reviewed on a regular basis.

All flat glass manufacturing plants obtained ISO, 9001, ISO 14001 and OHSAS 18001 certification, as did the transformation sites (ISO 14001).

1.8. Product processing / Installation

Not relevant. The construction process stage is not in the system boundary.

1.9. Packaging

Glass warehoused and transported in vertical position: by in-loader trucks (dedicated trailer stillage combinations). Wood, cardboard and metal ropes are used for fixation. Plastic film can be used for additional protection.

1.10. Condition of use

Not relevant. The use stage is not in the system boundary.

1.11. Environment and health during use

Intended usage of mirrored glass does not entail adverse environmental or health effects. No dangerous substances are released during the use of the product (see also section 6).

1.12. Reference service life

The reference service life (RSL) for mirrored glass is set at 10 years.

The RSL does not reflect the actual life time which typically is set by the lifetime and refurbishment of a building. The RSL is not referring to the warranty either.

1.13. Extraordinary effects (Fire, water, Mechanical destruction).

Not relevant.

1.14. Re-use phase

Glass is recyclable. AGC Flat Glass Europe leads an environmental policy that encourages recycling practice. Glass cullet from manufacturing and processing is commonly reintroduced in the glass manufacturing process. It decreases the required energy input for the furnaces. Cullet (internal + external) represents on average 30% of flat glass mass manufactured by AGC and use only glass cullet from other well-controlled glass process.

1.15. End-of-Life

According to European data, end-of-life building glass is almost never recycled into new glass products. Nowadays about 5% of end-of-life glazing from buildings is dismantled, collected separately and recycled for glass manufacturing (post-consumer cullet); about 95% ends up in demolition waste. Nevertheless, considering the lack of accurate statistical data, we assume a conservative approach and thus consider that 100% is treated as demolition waste.

The following waste codes (EU-codes according to Commission Decision 2000/532/EC and Annex III to Directive 2008/98/EC) can apply:

- 10 11 12: waste glass from manufacture of glass and glass products (pre-consumer glass cullet);
- 17 02 02: glass from construction and demolition waste (end-of-life glass);

LIFE CYCLE ASSESSMENT: CALCULATION RULES

2.1. Calculation rules

This EPD reports the results of the LCA in which the environmental impacts generated by material and energy flows involved in the manufacturing of mirrored glass are modelled and calculated. The LCA was performed in accordance with the product category rules set out in the European standard EN 15804+A1 and the LCA principles and requirements set out of ISO 14040 and ISO 14044.

2.2. Declared unit

The declared unit is 1 m² of silver-coated float glass.

2.3. System boundary

This document is a cradle-to-gate EPD, which covers a system including raw materials & energy supply, manufacturing of flat glass with associated transport (A1-A3). The installation and use stage is due to the diversity of application and construction not included in the calculation.

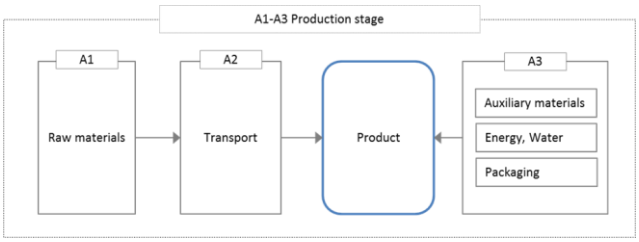


Figure 3 – System boundary: cradle-to-gate.

2.4. Data quality & Background data

Primary data on input/output and transport were collected from European based AGC production plants: 12 sites (15 float + 5 processing lines) and the AGC R&D centre. Other relevant data were obtained from manufacturer's information (e.g., product composition).

The production volumes of these sites were used to determine average values.

Background data were used from the GaBi 6.110 database (2015). European data sets were used for raw materials, auxiliary materials, energy, water and transport. Data choices focussed on

including the best fitting alternatives for all processes in the LCA-model.

The life cycle inventory (LCI) results were modelled and calculated using the GaBi software tool and a life cycle impact assessment (LCIA) was performed.

2.5. Period under review

The period under review is one year. Data from 2015 was used for this study.

2.6. Estimates and assumptions

Road transports were considered to return empty, transport per ship with a load. Operational data on transport distances were completed with estimates for local supplies (e.g., packaging). An average distance of 100 km was considered for these local supplies, all by road transport. Specific data was used for modelling raw materials transport, depending on supplier's distance.

2.7. Cut-off criteria

The production of the required machinery and equipment have not been considered.

Operational data (raw materials, energy, auxiliary and operating materials, waste, emissions to air and water) were utilised in the calculation. Also known material and energy flows of less than 1% were accounted. It can be assumed that the total of negligible processes does not exceed 5%.

2.8. Allocation

There is no allocation of co-products for the manufacturing and processing under consideration in this EPD.

2.9. Comparability

Basically, a comparison or an evaluation of EPD data is only possible if all data sets to be compared were created according to EN15804:2012+A1:2013 and the building context, respectively the product-specific characteristics of performance, are taken into account and for the same functional unit.

LIFE CYCLE ASSESSMENT (LCA): INVENTORY & INTERPRETATION

3.1. Description of the system boundary

The product stage is covered by this EPD (see point 3.3):

- Raw materials supply (A1);
- Transport (A2);
- Manufacturing (A3).

Below a selection of indicators is presented for the declared unit, i.e. 1 m² of flat glass, covered with silver coating with a painted protective back.

These indicators describe different types of environmental impact (e.g., global warming), input needs of resources (e.g., fresh water, energy) and output flows (e.g., waste) for a selected number of compositions with similar technical properties (U_g ,Tv, ρ_v , solar factor).

3.2. Environmental impact indicators

The life cycle impact assessment methods recommend by EN 15804+A1 were used. The impact indicators are presented below for the production stage (A1 - A3) for different thicknesses.

Table 1. Environmental impact categories

		4 mm	3 mm	8 mm
GWP	Global warming potential (100 years) [kg CO_2-eq.]	1,67E+01	1,36E+01	2,92E+01
ODP	Ozone depletion [kg CFC11-eq.]	1,64E-08	1,30E-08	3,01E-08
AP	Acidification for soil and water [kg SO_2-eq.]	1,55E-01	1,32E-01	2,47E-01
EP	Eutrophication potential [kg PO_4^{3-}- eq.]	1,44E-02	1,14E-02	2,67E-02
POCP	Formation potential of tropospheric ozone [kg Ethene eq.]	6,75E-03	5,81E-03	1,05E-02
ADPE	Abiotic depletion potential for non-fossil resources [kg Sb eq.]	4,92E-04	4,79E-04	5,43E-04
ADPFE	Abiotic depletion potential for fossil resources [MJ]	2,22E+02	1,82E+02	3,82E+02

The environmental impacts of the declared products are primarily determined by the manufacturing process of the flat glass, and, the upstream energy & raw materials provision. It contributes for about:

- The global warming potential (GWP) is mainly due to carbon dioxide emissions and around 78% are due to the float glass process. Silvering and protective back layer of paint contributes a bit less than 20% on the total GWP emissions. From the latter, the upstream production of the raw materials is the main source of impact (±75%), with transport of involved accounting for ±25% of it. The energy provision is less relevant contributing around 2,5%;
- Almost 50% of the ozone depletion potential (ODP), is predominantly due to CFC (chlorofluorocarbons) involved in upstream processes of the glass substrate manufacturing. Some raw materials of the paint process are also relevant contributors (±17%). Around 30% of the emissions are due to material used in the cleaning steps. Process energy is around 2% relevant;
- ±65% of the acidification potential (AP), mainly arising from sulphur dioxide and nitrogen oxides emissions from the manufacturing of the flat glass with the associated energy provision. The silvering step contributes to a lesser extent (±30%), being 5% due to transport. Process energy around 1% of the total;
- 85 to 95% to the eutrophication potential (EP) are emitted during glass manufacturing - where nitrogen oxides are the main contributor. The silvering is responsible for less than 10% of the emissions;
- Around 70% of the photochemical ozone creation potential (POCP), predominantly as a result of sulphur dioxide and nitrogen oxides emitted during flat glass production. Silvering accounts for less than 28-30%;
- Silvering and paint steps are responsible for up to ±90% of the abiotic depletion potential of non-renewable material resources (ADPE);
- The abiotic depletion potential of fossil resources (ADPFE) is predominantly due to fossil fuels used in the glass manufacturing process and fossil fuels and uranium for electricity provision. Process energy is around 5% and silvering and painting for up to almost 20%;

The influence of the transport and water provision related to float glass production is for most of these indicators marginal.

3.3. Resource use

The results for resource use are presented in Table 2 for the different thickness of mirrored glass.

Table 2. Resource use

		4 mm	3 mm	8 mm
PERT	Primary energy resources, total renewable [MJ]	1,55E+01	1,29E+01	2,60E+01
PENRT	Primary energy resources, total [MJ]	2,63E+02	2,14E+02	4,60E+02
FW	Fresh water use [m³]	2,05E-01	1,99E-01	2,30E-01

The primary energy use related to the production of mirrors glass sheets (253 MJ) is dominated by the production of the flat glass sheets, i.e. ±75% (*4 mm thickness*). Heavy fuel and natural gas are significant energy sources (non-renewables) in the manufacturing process. Silvering accounts for about 15% of the total emissions while transport (all) is responsible for less than 4%. Process energy contributes for ±5%. The product uses 5% of total renewable primary energy (PERT).

The fresh water demand is about 40% due to production of cleaning, silvering, and paint materials including the water involved during the process (±3%).

3.4. Waste categories

The results for waste flows are presented in Table 3.

Table 3. Waste categories

		4 mm	3 mm	8 mm
HWD	Hazardous waste disposed [kg]	1,94E-03	1,94E-03	1,97E-03
NHWD	Non-hazardous waste disposed [kg]	1,92E-01	1,46E-01	3,77E-01
RWD	Radioactive waste disposed [kg]	8,93E-03	7,91E-03	1,30E-02

The non-hazardous waste (including inert waste) is mainly generated by the processes upstream for raw materials. Waste

from the line/process is less than 5%. The hazardous waste is predominantly due to the upstream processes for silvering material and process energy production. Radioactive waste is generated exclusively linked to electricity supply (nuclear power stations) for the manufacturing and all upstream processes. Generally speaking, mirror production results in a high concentration of ammonia in the effluent from the silvering line. Some 90% of this ammonia comes from the coppering process. Thus, copper-free mirrors help processors minimize polluted emissions, since the effluent from shaping operations is totally free of copper.

Furthermore, following AGC Environmental Policy and the objective of zero waste to landfill, none of the assessed sites has sent waste to be landfilled. Most of the waste was either recycled or recovered (± 88%).

Estimate for other structures:

On the basis of the results presented in this EPD, conservative estimates of environmental indicators, resources uses and waste quantities can be made for other applications:

- For glass sheets with a thicknesses other than those mentioned in the tables (e.g., 5 mm, 12 mm, 15 mm, 19 mm): by dividing the impact indicator of the reference structure by its thickness (namely 4) and multiplying it by its proper thickness (e.g., 8). Considering this, each 1 mm of 1 m^2 of mirror has a GWP = 4,17 [kg CO_2-eq.].

The same calculation can be performed for other categories (e.g. water use, waste, etc.). Please take into account that the above mentioned allows to calculate a rough estimate. Emissions from glass substrate are linear dependent of the thickness of the product while the following steps (e.g. silvering, paint, etc.) only vary with the m^2 of the unit, i.e. they are mainly constant for the functional unit considered.

REQUISITE EVIDENCE

4.1. Volatile organic compounds (VOC)

Mirox MNGE is labelled in the top category "A+" following accredited testing, in accordance with the French Décret No. 2011-321 du 23 mars 2011, completed by l'Arrêté du 19 avril 2011 which regard to the labelling of construction products on emissions of volatile compounds. For more information please see **REACH** and **VOC declaration** available under the *tools* section at www.yourglass.com.

ADDITIONAL INFORMATION

5.1. Decorative products

Rising to the demand for advances in resistance, processing and performance, this new generation of ecological mirrors stands out for its copper-free metal coating, the use of low-level lead paints and its high resistance to corrosion.

Advantages of Mirox New Generation Ecological:

- Easy to clean and highly resistant to harsh cleaning products;
- Available in a SAFE/SAFE+ version: this is a safety film applied to the back of the glass (uniform) which ensures safety (comply with EN12600);
- Preserves indoor air quality by emitting very low levels of Volatile Organic Compounds (VOCs) and formaldehyde;
- Can resist up to 80°C (for uniform heated volumes);
- MNGE mirrors are Cradle to Cradle Certified;

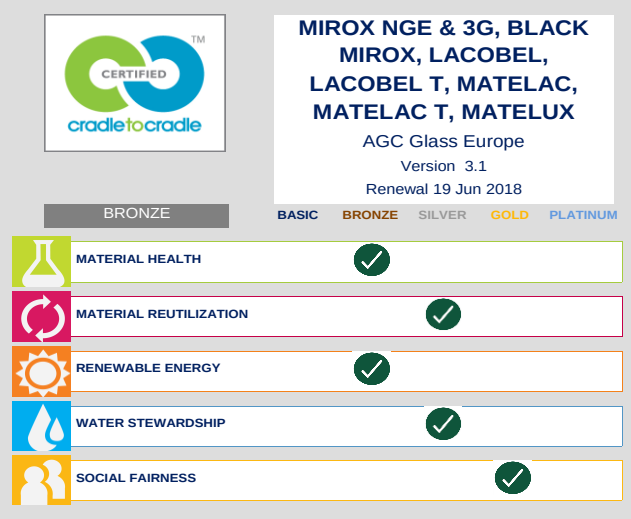
A product rewarded for its excellence

The ecological excellence of Mirox New Generation Ecological has been rewarded with a number of awards bestowed by glass production experts and industrial troubleshooters. These awards reflect the efforts that AGC has made to help protect the environment. They include:

- The "British Industry Award" for environmental initiative: an award given by Glassex (the UK specialist glass fair).
- The "Prix de l'Environnement" awarded by the FEB (the Federation of Belgian Companies).
- The special commendation made in the "Eco-design" category at the European Better Environment Awards for Industry (sponsored by the European Commission).

5.2. Cradle-to-Cradle (C2C) certification

AGC Glass Europe laminated range has achieved Cradle to Cradle Certified^{CM} Bronze (Version 3.1).



AGC is the first and so far the only European glass manufacturer to offer a wide range of products bearing the Cradle to Cradle Certified^{CM} label. C2C is the brainchild of German chemist Michael Braungart and American architect William McDonough.

The concept is broader than recycling and rather than focusing on reducing consumption, it focuses on aligning products into a more sustainable business (eco-effectiveness) in complementary ways to our product's life cycle assessment (eco-efficiency). LCA is used in complement to assess the different solutions that C2C envisions and help us keeping track in where we stand regarding to our existing environmental footprint.

C2C help us to design each product in such a way that it does not go from the cradle to the grave, but into a new cradle. Furthermore and while many certifications address one particular aspect of a product, the C2C Product Standard addresses five categories relating to human and environmental health. In order to achieve certification, a product must meet strict standards in all five categories. AGC exceeds the basic

requirements in each of these categories.

The added value of AGC products for buildings:

The new LEED Version 4 for new constructions, there is an increased awareness of the importance of developing a transparency policy at product level. Thus, it assures points to products with a C2C and products that have third-party verified EPDs. In this new version, Cradle to Cradle Certified™ products and our EPDs can contribute to additional points in the Materials & Resources section. This credit encourages project teams to choose "healthier products and materials" in order to minimise the use and generation of harmful substances while endorsing the use of materials for which life cycle information is available. Hence, by using AGC's EPDs and Cradle to Cradle Certified™ products, architects and builders are eligible to earn direct points.

As well as being a standardised report, EPDs can also be incorporated into Building Information Models (BIM).

For more information please visit: www.yourglass.com/

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Cradle to Cradle Products Innovation Institute
http://www.c2ccertified.org/

Photo Credits

Right: Mirox MNGE SAFE Clear 4mm, Matelac Pure White SAFE 4mm - wall cladding. Courtesy Note: © AGC Glass Europe and SIKO KOUPELNY & KUCHYNE. Left: Mirox Safe+ mirror and Oltreluce Silver Waves wall covering. Cortesy Note: AGC Glass Building - © Project : Philippe SAMYN and PARTNERS sprl, architects and engineers – BEAI sa

Additional information available at www.yourglass.com

and in the « Environment » section at www.agc-glass.eu