ENVIRONMENTAL PRODUCT DECLARATION

as per ISO 14025 and EN 15804

Owner of the Declaration	ARGE; European Federation of Associations of Lock and Builders Hardware Manufacturers
Programme holder	Institut Bauen und Umwelt e.V. (IBU)
Publisher	Institut Bauen und Umwelt e.V. (IBU)
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Valid to	13.09.2022

Single-axis hinges

ARGE; European Federation of Associations of Lock and Builders Hardware Manufacturers

(This EPD is valid only for products supplied by an ARGE EPD licence holder)

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1. General Information

ARGE	Single-axis hinges
Programme holder IBU - Institut Bauen und Umwelt e.V. Panoramastr. 1 10178 Berlin Germany	**Owner of the Declaration** ARGE; European Federation of Associations of Lock and Builders Hardware Manufacturers Offerstraße 12, 42551 Velbert Germany
Declaration number EPD-ARG-20160193-IBG2-EN	**Declared product / Declared unit** 1 kg of hinges
This Declaration is based on the Product Category Rules: Building Hardware products, 02.2016 (PCR tested and approved by the SVR) **Issue date** 14.09.2016 **Valid to** 13.09.2022	**Scope:** This ARGE EPD covers products used to enable doors and windows in buildings to pivot about a fixed axis. The reference product used to calculate the impact this product group has on the environment is a single-axis hinge composed primarily of zinc-based alloy, steel and aluminium, and has been selected for the LCA (Life Cycle Assessment) because it is the product with the highest impact for 1 kg of product. A validity scope analysis has also been carried out to determine the limiting factors for single-axis hinges covered by this EPD. In a preliminary study (simplified LCA), it has been confirmed that this EPD represents the worst case condition and it can therefore be used to cover all single-axis hinges manufactured in Europe by ARGE member companies. The owner of the declaration shall be liable for the underlying information and evidence, but the ARGE programme holder (IBU) cannot be held responsible for manufacturer's information, life cycle assessment data or evidence
Prof. Dr.-Ing. Horst J. Bossenmayer (President of Institut Bauen und Umwelt e.V.)	**Verification** The CEN Norm /EN 15804/ serves as the core PCR Independent verification of the declaration according to /ISO 14025/ ☐ internally ☒ externally
Dr. Burkhart Lehmann (Managing Director IBU)	Dr. Frank Werner (Independent verifier appointed by SVR)

2. Product

2.1 Product description
This EPD covers products used to enable doors and windows in buildings to pivot about a fixed axis - including those with a spring action.

2.2 Application
These products are designed to be integrated into door and window assemblies of varying materials and applications. Their purpose is to provide the door or window with the means to pivot about a fixed axis.. They may be used for either interior or exterior doors or windows.

2.3 Technical Data
Ideally, products should comply with a suitable technical specification. /EN 1935/ is an example of such a specification and some products will comply with this. The relevant grading structure is shown in the following table

Name	Value	Unit
Category of use	1 - 3	Grade
Durability	1 - 3	Grade
Test door mass	1 - 10	Grade
Suitability for fire resistance & smoke control doors	0, A, B	Grade
Safety	1	Grade
Corrosion resistance	0 - 5	Grade
Security – burglar resistance	0 - 1	Grade
Hinge grade	2 - 17	Grade

2.4 Application rules
For construction products placed on the market EU Regulation No 305/2011 "Construction products regulation" might apply. If requested relating to their use, single-axis hinges shall be CE marked to harmonized product standard /EN 1935/ Building hardware - Single-axis hinges, and shall have a Declaration of Performance. For spring hinges hEN1935 does not apply. Thus
theese products cannot be CE-marked at this time.
For application and use, additional national provisions may also apply.

2.5 Delivery status
The products are sold by unit. Deliveries of a single unit might be possible but will be an exception. Regular deliveries will cover a larger amount of hinges as they are put on the market as "B2B" product and not for a final customer.

2.6 Base materials / Ancillary materials

Composition of product analysed for this EPD
The values given in the table below are for the product analysed for this EPD. Ranges of values for other products covered by the validity scope analysis are shown in brackets.

Name	Value	Unit
Zinc-based alloy (0.00% – 74.06%)	74.1	%
Steel (0.00% – 98.90%)	17.3	%
Aluminium (0.00% – 41.46%)	8.65	%
Stainless steel (0.00% – 52.89%)	0	%
Nylon 6 (0.00% – 5.65%)	0	%

The product contains no substances cited on the REACH list of hazardous substances.

Zinc-based alloy is an alloy of four separate metals: zinc, aluminium, magnesium and copper. Sub-components of hinges made from zinc-based alloy are diecast.
Aluminium is a non-ferrous metal produced from bauxite by the Bayer process. Sub-components made of aluminium are made by extrusion.
Steel is produced by combining iron with carbon as well as other elements depending on the desired characteristics. The sub-components made of steel are formed by stamping.

2.7 Manufacture
The production of a hinge normally follows a 3 step procedure:
1. Prefabrication of the semi-finished products, this step might include a surface treatment on factory site or by external manufacturers.
2. Preassembly of assembly modules (onsite factory)
3. Final assembly (onsite factory)

2.8 Environment and health during manufacturing
Regular measurements of air quality and noise levels are performed by ARGE member manufacturers. The results shall be within the compulsory safety levels. In areas where employees are exposed to chemical products, prescribed safety clothes and technical safety devices shall be provided. Regular health checks are mandatory for employees of production sites.

2.9 Product processing/Installation
The installation of the product could vary depending on the type of door and the specific situation but products shall not require energy consumption for installation.

2.10 Packaging
Normally each single product is packaged in paper. Hinges are then packed by batch in a cardboard box and stacked on wooden pallets for transport to the customer (Door or window manufacturer).
Waste from product packaging is collected separately for waste disposal (including recycling).

2.11 Condition of use
Once installed, the products shall require no servicing during their expected service lives. There shall be no consumption of water or energy linked to their use, and they do not cause any emissions.

2.12 Environment and health during use
No environmental damage or health risks are to be expected during normal conditions of use.

2.13 Reference service life
The Reference Service Life is 30 years under normal working conditions. This corresponds to passing a mechanical endurance test of 200.000 cycles as specified in the /EN 1935/. The Reference Service Life is dependent on the actual frequency of use and environmental conditions. It is required that installation, as well as maintenance of the product, must be done in line with instructions provided by the manufacturer.

2.14 Extraordinary effects

Fire
The product is suitable for use in fire resisting and/or smoke control door or window set according to one of the classes in /EN 1935/.

Water
The declared product is intended to be used in buildings under normal conditions (indoor or outdoor). It shall not emit hazardous substances in the event of flooding.

Mechanical destruction
Mechanical destruction of the declared product shall not materially alter its composition or have any adverse effect on the environment.

2.15 Re-use phase
Removal of the hinge (for re-use or re-cycling) shall have no adverse effect on the environment.

2.16 Disposal
Hinge components should be re-cycled wherever possible, providing that there is no adverse effect on the environment. The waste code in accordance with the /European Waste Code/ is17 04 07.

2.17 Further information
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Details of all types and variants to be shown on the manufacturers' websites listed on
http://arge.org/members/members-directory.html

3. LCA: Calculation rules

3.1 Declared Unit

The declared unit for all products covered by ARGE EPD is 1 kg (of product). Since individual products will rarely weigh exactly 1 kg it is necessary to establish the exact weight of the product then use this as a correction factor to determine the true values for 1 kg of product in the tables (Section 5).
A total of 6 typical products (based on sales figures) have been evaluated and the worst case results are used in the tables

Correction factor

Name	Value	Unit
Declared unit mass	1	kg
Mass of declared product	0.613	kg
Correction factor	Divide by 0.613	

3.2 System boundary

The type of the EPD covers “cradle-to-grave” requirements.
The analysis of the product life cycle includes the production and transport of the raw materials, manufacture of the product and the packaging materials, which are declared in modules A1-A3. Losses during production are considered as waste and are sent for recycling. No recycling processes are taken into account except transport and an electricity consumption for grinding the metals. When recycled metals are used as raw material, only their transformation process is taken into account, not the extraction process.
A4 module represents the transport of the finished product to the installation site.
There is no waste associated with the installation of the product. The A5 module therefore represents only the disposal of the product packaging.
For the RSL considered for this study, there are no inputs or outputs for the stages B1-B7.
The End-of-Life (EoL) stages are also considered. The transportation to the EoL disposal site is taken into account in module C2. Module C4 covers the disposal of hinges. Module C3 covers the recycling of the individual elements according to European averages, with the remaining waste divided between incineration and landfill. The same assumption as for waste to recycling in A3 is used here.
For end of life modules (C1 to C4) the system boundaries from the /XP P01-064/CN/ standard have been followed, see annex H.2 and H.6 of this standard document for figures and further details.

In practice, the end-of-life has been modelled as follows:
- When material is sent for recycling, generic transport and electric consumption of a shredder is taken into account (corresponding to the process “Grinding, metals”). Only then is the material considered to have attained the “end of waste” state.
- Each type of waste is modelled as transport to the treatment site with a distance of 30 km (source: /FD P01-015/). Parts sent for recycling include an electricity consumption (grinding) and a flow (“Materials for recycling, unspecified”).

Four scenarios for the end of life of the products have been declared for this EPD:

1. 100% of the product going to landfill
2. 100% of the product going to incineration
3. 100% of the product going to recycling
4. Mixed scenario consisting of the previous three scenarios, values depending of the amount of waste going to recycling.

Module D has not been declared.

3.3 Estimates and assumptions

The LCA data of the declared hinges has been calculated by the production data of in total 2 ARGE member companies, representing 6 different products. These companies had been chosen by ARGE as being representative by means of their production processes and their market shares. The hinge chosen as representative for this calculation follows the "worst case" principle as explained under 6. LCA interpretation.

3.4 Cut-off criteria

The cut -off criteria considered are 1% of renewable and non-renewable primary energy usage and 1% of the total mass of that unit process. The total neglected input flows per module shall be a maximum of 5% of energy usage and mass.
For this study, all input and output flows have been considered at 100%, including raw materials as per the product composition provided by the manufacturer and packaging of raw materials as well as the final product. Energy and water consumptions have also been considered at 100% according to the data provided.
With the approach chosen, no significant environmental impacts are known to have been cut-off.

3.5 Background data

For life cycle modelling of the considered product, all relevant background datasets are taken from the ecoinvent 3.1 – Alloc Rec database. The life cycle analysis software used is SimaPro (V8.0.5), developed by PRé Consulting.

3.6 Data quality

The time factor and the life cycle inventory data used comes from:
Data collected specifically for this study comes from ARGE manufacturers’ sites. Data sets are based on 1-year averaged data (time period: January 2013 to December 2013).
In the absence of collected data, generic data from the /ecoinvent V3/ database. It is updated regularly and is representative of current processes (the entire database having been updated in 2014).

3.7 Period under review

The data of the LCA is based on the annual production data of several ARGE member companies from 2013. Other values, e.g. for the processing of the base materials, are taken from the /ecoinvent v3/.1 Alloc Rec where the dataset age varies for each dataset, see ecoinvent documentation for more information.

3.8 Allocation

The products are produced in numerous production sites. All data was provided by the manufacturers of the products per unit and then divided by the mass of the product to give a value per kg of product produced.

The assumptions relating to the EoL of the product are described in the section System Boundaries.

3.9 Comparability

Basically, a comparison or an evaluation of EPD data is only possible if all the data sets to be compared were created according to /EN 15804/ and the building context, respectively the product-specific characteristics of performance, are taken into account. The used background database has to be mentioned.

4. LCA: Scenarios and additional technical information

The following technical information is a basis for the declared modules or can be used for developing specific scenarios in the context of a building assessment for Modules Not Declared (MND).

Transport to the building site (A4)

Name	Value	Unit
Litres of fuel	0.0045	l/100km
Transport distance	3500	km
Capacity utilisation (including empty runs)	36	%

Installation into the building (A5)

Name	Value	Unit
Material loss	0.138	kg

Reference service life

Name	Value	Unit
Reference service life (condition of use: see §2.13)	30	a

End of life (C1-C4)

Name	Value	Unit
Collected separately (All scenarii)	1	kg
Recycling (Mixed scenario)	0.251	kg
Energy recovery (Mixed scenario)	0.345	kg
Landfilling (Mixed scenario)	0.404	kg
Incineration (100% incineration scenario) Scenario 1	1	kg
Landfilling (Landfill scenario) Scenario 2	1	kg
Recycling (100% recycling scenario) Scenario 3	1	kg

It is assumed that a 16-32 ton truck is used to transport the product over the (Up to) 30 km distance between the dismantling site and the next treatment (source: FD P01-015).

Reuse, recovery and/or recycling potentials (D), relevant scenario information

As Module D has not been declared, materials destined for recycling have been accounted for in the indicator “Materials for recycling” however, no benefit has been allocated.

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5. LCA: Results

In Table 1 "Description of the system boundary", the declared modules are indicated with an "X"; all modules that are not declared within the EPD but where additional data are available are indicated with "MND". Those data can also be used for building assessment scenarios. The values are declared with three valid digits in exponential form.

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 from the gate to the site	Assembly	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	De-construction demolition	Transport	Waste processing	Disposal	Reuse-Recovery-Recycling-potential
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
X	X	X	X	X	MND	MND	MND	MND	MND	MND	MND	X	X	X	X	MND

RESULTS OF THE LCA - ENVIRONMENTAL IMPACT: 1 kg of hinge

Parameter	Unit	A1-A3	A4	A5	C1	C2	C2/1	C2/2	C2/3	C3	C3/1	C3/2	C3/3	C4	C4/1	C4/2	C4/3
GWP	[kg CO_2-Eq.]	6.54E+0	5.89E-1	1.37E-2	0.00E+0	5.05E-3	5.05E-3	5.05E-3	5.05E-3	4.17E-3	0.00E+0	0.00E+0	8.66E-3	0.00E+0	5.23E-1	4.97E-1	0.00E+0
ODP	[kg CFC11-Eq.]	4.27E-7	1.08E-7	3.62E-10	0.00E+0	9.26E-10	9.26E-10	9.26E-10	9.26E-10	4.47E-10	0.00E+0	0.00E+0	9.30E-10	0.00E+0	4.02E-9	3.43E-9	0.00E+0
AP	[kg SO_2-Eq.]	7.15E-2	2.39E-3	1.42E-5	0.00E+0	2.05E-5	2.05E-5	2.05E-5	2.05E-5	1.73E-5	0.00E+0	0.00E+0	3.60E-5	0.00E+0	2.58E-4	1.24E-4	0.00E+0
EP	[kg $(PO_4)^{3-}$-Eq.]	9.66E-3	4.06E-4	6.32E-6	0.00E+0	3.48E-6	3.48E-6	3.48E-6	3.48E-6	1.94E-6	0.00E+0	0.00E+0	4.04E-6	0.00E+0	7.52E-5	5.94E-4	0.00E+0
POCP	[kg ethene-Eq.]	4.46E-3	2.68E-4	3.23E-6	0.00E+0	2.30E-6	2.30E-6	2.30E-6	2.30E-6	9.54E-7	0.00E+0	0.00E+0	1.98E-6	0.00E+0	1.60E-5	1.41E-4	0.00E+0
ADPE	[kg Sb-Eq.]	6.47E-3	1.95E-6	4.12E-9	0.00E+0	1.67E-8	1.67E-8	1.67E-8	1.67E-8	1.70E-9	0.00E+0	0.00E+0	3.53E-9	0.00E+0	4.69E-8	2.47E-8	0.00E+0
ADPF	[MJ]	8.68E+1	8.97E+0	3.33E-2	0.00E+0	7.69E-2	7.69E-2	7.69E-2	7.69E-2	6.39E-2	0.00E+0	0.00E+0	1.33E-1	0.00E+0	3.73E-1	2.80E-1	0.00E+0

Caption	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

RESULTS OF THE LCA - RESOURCE USE: 1 kg of hinge

Parameter	Unit	A1-A3	A4	A5	C1	C2	C2/1	C2/2	C2/3	C3	C3/1	C3/2	C3/3	C4	C4/1	C4/2	C4/3
PERE	[MJ]	1.15E+1	1.12E-1	2.07E-3	0.00E+0	9.61E-4	9.61E-4	9.61E-4	9.61E-4	8.27E-3	0.00E+0	0.00E+0	1.72E-2	0.00E+0	1.14E-2	2.11E-2	0.00E+0
PERM	[MJ]	2.22E+0	0.00E+0	-1.41E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
PERT	[MJ]	1.37E+1	1.12E-1	-1.40E+0	0.00E+0	9.61E-4	9.61E-4	9.61E-4	9.61E-4	8.27E-3	0.00E+0	0.00E+0	1.72E-2	0.00E+0	1.14E-2	2.11E-2	0.00E+0
PENRE	[MJ]	9.17E+1	9.13E+0	3.97E-2	0.00E+0	7.82E-2	7.82E-2	7.82E-2	7.82E-2	9.38E-2	0.00E+0	0.00E+0	1.95E-1	0.00E+0	3.86E-1	3.53E-1	0.00E+0
PENRM	[MJ]	2.86E-1	0.00E+0	-7.01E-2	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
PENRT	[MJ]	9.20E+1	9.13E+0	-3.04E-2	0.00E+0	7.82E-2	7.82E-2	7.82E-2	7.82E-2	9.38E-2	0.00E+0	0.00E+0	1.95E-1	0.00E+0	3.86E-1	3.53E-1	0.00E+0
SM	[kg]	1.85E-1	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
RSF	[MJ]	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
NRSF	[MJ]	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
FW	[m^3]	8.71E-2	1.72E-3	2.78E-5	0.00E+0	1.48E-5	1.48E-5	1.48E-5	1.48E-5	3.15E-5	0.00E+0	0.00E+0	6.54E-5	0.00E+0	1.17E-3	3.42E-4	0.00E+0

Caption	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

RESULTS OF THE LCA – OUTPUT FLOWS AND WASTE CATEGORIES: 1 kg of hinge

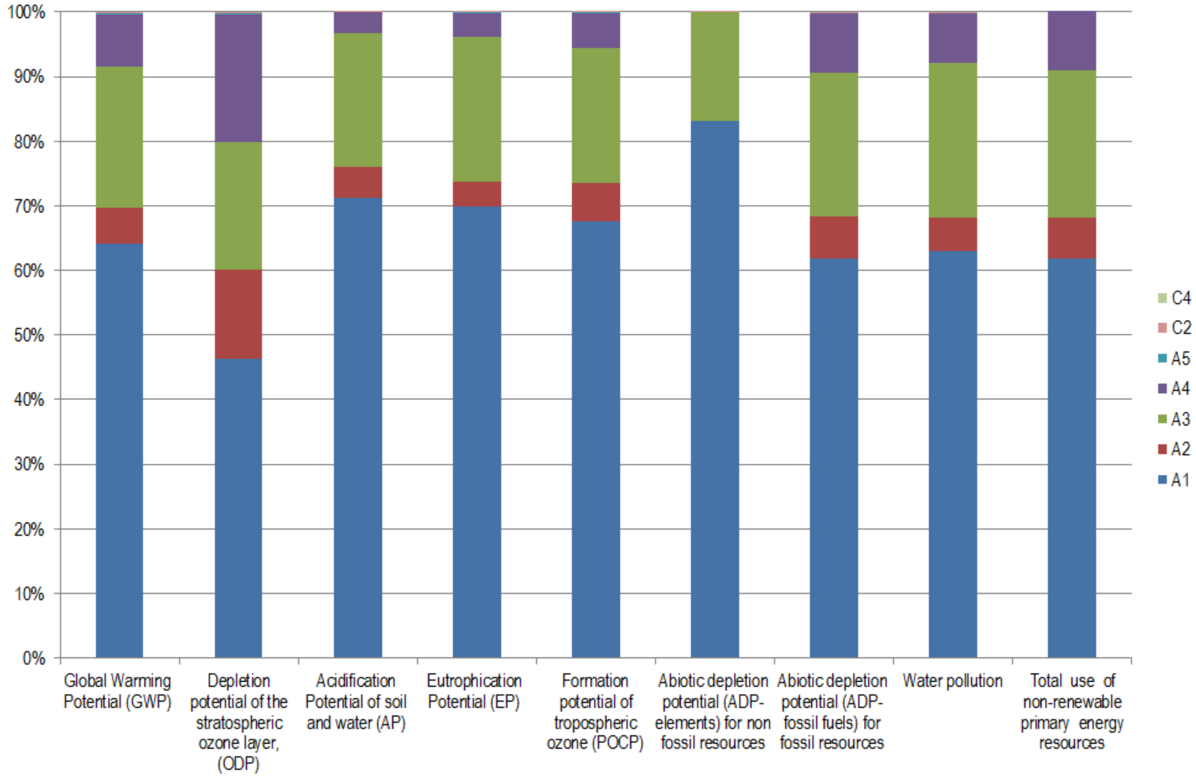
Parameter	Unit	A1-A3	A4	A5	C1	C2	C2/1	C2/2	C2/3	C3	C3/1	C3/2	C3/3	C4	C4/1	C4/2	C4/3
HWD	[kg]	5.78E-1	5.64E-3	3.15E-4	0.00E+0	4.83E-5	4.83E-5	4.83E-5	4.83E-5	2.95E-4	0.00E+0	0.00E+0	6.14E-4	0.00E+0	2.66E-1	1.24E-3	0.00E+0
NHWD	[kg]	5.83E+0	4.68E-1	2.56E-2	0.00E+0	4.01E-3	4.01E-3	4.01E-3	4.01E-3	1.33E-3	0.00E+0	0.00E+0	2.77E-3	0.00E+0	1.45E-2	1.00E+0	0.00E+0
RWD	[kg]	2.08E-4	6.13E-5	2.24E-7	0.00E+0	5.25E-7	5.25E-7	5.25E-7	5.25E-7	5.07E-7	0.00E+0	0.00E+0	1.05E-6	0.00E+0	1.35E-6	2.65E-6	0.00E+0
CRU	[kg]	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
MFR	[kg]	2.00E-1	0.00E+0	9.98E-2	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	4.81E-1	0.00E+0	0.00E+0	1.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
MER	[kg]	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0
EEE	[MJ]	0.00E+0	0.00E+0	3.29E-2	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	1.39E+0	0.00E+0	0.00E+0
EET	[MJ]	0.00E+0	0.00E+0	6.85E-2	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	0.00E+0	2.85E+0	0.00E+0	0.00E+0

Caption	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; EEE = Exported electrical energy; EEE = Exported thermal energy

Other end of life scenarios have been calculated in order to build specific end of life scenario at the building level:
- scenario 1: the product is considered to be 100% incinerated
- scenario 2: the product is considered to be 100% landfilled
- scenario 3: the product is considered to be 100% recycled

6. LCA: Interpretation

This chapter contains an interpretation of the Life Cycle Impact Assessment categories. When expressed as a percentage, the impact refers to its magnitude expressed as a percentage of total product impact across all modules, with the exception of module D.
The raw material extraction (A1) phase is the main contributor to all indicators mainly due to zamak extraction and production. The impacts of the production phase (A3) range between 10 and 20 %. Finally, transport phases A2 and A4 have non-negligible impacts especially for the ODP indicator. The results are conservative as complying with the composition given in section 2.6



7. Requisite evidence

No testing results are required by the PCR part B.

8. References

ISO 14040
ISO 14040:2006-10, Environmental management – Life cycle assessment – Principles and framework (ISO 14040:2006); German and English version EN ISO 14040:2006

DIN EN ISO 14044
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Institut Bauen und Umwelt e.V.
Panoramastr. 1
10178 Berlin
Germany

Tel +49 (0)30 3087748- 0
Fax +49 (0)30 3087748- 29
Mail info@ibu-epd.com
Web **www.ibu-epd.com**

Programme holder
Institut Bauen und Umwelt e.V.
Panoramastr 1
10178 Berlin
Germany

Tel +49 (0)30 - 3087748- 0
Fax +49 (0)30 – 3087748 - 29
Mail info@ibu-epd.com
Web **www.ibu-epd.com**

Author of the Life Cycle Assessment
CETIM
rue de la presse 7
42952 Saint-Etienne Cedex 1
France

Tel 0033477794042
Fax 0033477794107
Mail sqr@cetim.fr
Web **www.cetim.fr**

Owner of the Declaration
ARGE; European Federation of Associations of Lock and Builders Hardware Manufacturers
Offerstraße 12
42551 Velbert
Germany

Tel +49 (0)2051 9506 36
Fax +49 (0)2051 9506 25
Mail info@arge.org
Web **www.arge.org**