ENVIRONMENTAL PRODUCT DECLARATION

in accordance with ISO 14025 and EN 15804

Declaration holder	Gesamtverband der Aluminiumindustrie e.V. (German Aluminium Association GDA)
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Aluminium composite panels

GDA – Gesamtverband der Aluminiumindustrie e.V. (German Aluminium Association)

Institut Bauen und Umwelt e.V.

ECO PLATFORM EPD EN 15804 VERIFIED

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1. General information

Gesamtverband der Aluminiumindustrie e.V. (German Aluminium Association GDA)	Aluminium composite panels
Programme holder IBU – Institut Bauen und Umwelt e.V. Panoramastr. 1 10178 Berlin Germany	**Owner of the Declaration** Gesamtverband der Aluminiumindustrie e.V. (German Aluminium Association GDA) Am Bonneshof 5 40474 Düsseldorf Germany
Declaration number EPD-GDA-20130261-IBG1-EN	**Declared product/unit** 1 m² aluminium composite panels
This Declaration is based on the Product Category Rules: Products of aluminium and aluminium alloys, 10-2012 (PCR tested and approved by the independent Expert Committee (SVA))	**Area of applicability:** This document refers to the manufacture of 1 m² aluminium composite panels. It represents a sample EPD drawn up on the basis of 5 products weighted by the production volumes of 2 member companies. On account of the comparable production technologies used by the individual companies, good data representativity can be assumed. The data collated concerns the period 2011 and 2012. Liability by IBU concerning manufacturer's information, LCA data and evidence is excluded.
Issue date 18.11.2013	
Valid until 17.11.2018	**Verification** The EN 15804 CEN standard serves as the core PCR. Verification of the EPD by an independent third party in accordance with ISO 14025 ☐ internally ☒ externally
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Dr.-Ing. Burkhart Lehmann (Managing Director IBU)	Matthias Schulz (Independent verifier appointed by the SVA)

2. Product

2.1 Product description
Aluminium composite panels are thin sandwich panels of a symmetric design comprising aluminium top layers and a thermoplastic core. These aluminium composite panels involve semi-finished products for the construction industry, automotive and marine applications, rail-bound vehicles etc. (e.g. for facades, panelling, furniture etc.).

2.2 Application
Aluminium composite panels are used as lightweight panelling elements for curtain facades (DIN 18516-1), lower ceilings, roofs and wall panelling and as symmetrical or bent panels or cassettes in interior applications. Aluminium composite panels are suitable for use in large-surface applications with high demands on symmetry and rigidity.

2.3 Technical data
The construction data listed here is of relevance for the product.

Construction data

Description	Value	Unit
Linear thermal expansion rate to EN ISO 6892-1	2.4	$10^{-6}K^{-1}$
Elasticity module to EN ISO 6892-1	70000	N/mm^2
Yield strength Rp 0.2 min. to EN ISO 6892-1	>=90	N/mm^2
Tensile strength Rm min. to EN ISO 6892-1	>=130	N/mm^2
Elongation at break A5 min. to EN ISO 6892-1	5	%
Aluminium composite panels, normal flammability	-	-
3 mm panel weight (dimensioning)	0.45	kN/m²
4 mm panel weight (dimensioning)	0.55	kN/m²
6 mm panel weight (dimensioning)	0.75	kN/m²
Aluminium composite panels, flame-retardant/non-combustible	-	-
3 mm panel weight (dimensioning)	0.60	kN/m²
4 mm panel weight (dimensioning)	0.75	kN/m²
6 mm panel weight (dimensioning)	1.10	kN/m²

Description	Value	Unit
All panel types	-	-
3 mm panel stiffness EI	1250	kN cm^2/m
4 mm panel stiffness EI	2400	kN cm^2/m
6 mm panel stiffness EI	5900	kN cm^2/m
3 mm moment of resistance W	1.25	cm^3/m
4 mm moment of resistance W	1.75	cm^3/m
6 mm moment of resistance W	2.75	cm^3/m

2.4 Placing on the market / Application rules

Aluminium composite panels are used in accordance with a general construction approval.

2.5 Delivery status

	Min.	Max.	Preferred dimensions
Thickness	2 mm	8 mm	4 mm
Width	-	2050 mm	1250 - 1500 mm
Length	-	12000 mm	2500 - 6000 mm

2.6 Base materials / Auxiliaries

Composition as % by weight

Description	Value	Unit
Aluminium	32 - 49	%
Core layer	33 - 61	%
PE foil	4 - 27	%

Aluminium composite panels are thin sandwich panels (2 – 8 mm) with aluminium top layers (approx. 0.5 mm) (polished to EN 485, see EPD Blank Aluminium Sheet No. EPD-GDA-20130258-IBG1-DE, coil-coated to EN 1396, see EPD Coil-Coated Aluminium Sheet No. EPD-GDA-20130259-IBG1-DE) and a generally thermoplastic core layer (e.g. PE, PP, EVA). Typical aluminium alloys for the construction sector comply with the 3000 and 5000 series to DIN EN 573-3.
Prior to varnishing, a conversion layer is applied as surface pre-treatment. This can contain chromate or chrome III or be chrome-free.

2.7 Production

Rolling ingots are usually cast from the application-specific aluminium alloy via a continuous casting process. These rolling ingots are slid between two rotating steel rollers which are spaced a little less than the thickness of the rolling pieces. Friction causes entrainment by the rollers and compression to the space between the rollers. This reshaping is primarily lengthwise causing the rolled pieces to elongate.
Several rolling processes are usually required in order to obtain the final thickness. Thermal treatment is performed in order to achieve the required material properties in terms of formability and strength. The aluminium strips are coated in a continuous coil coating process until the final width. Solvents used during this process are collected and thermally utilised for drying the varnishes.
The coated strips are then laminated and cut to length in a further process involving a continuously manufactured core (e.g. extrusion).

2.8 Environment and health during production

Over the past few years, the European semi-finished aluminium products industry has successfully made a great effort in terms of conservation of the environment and resources.
For example: on-going optimisation of rolling and coating processes for aluminium sheet contribute to efficiency of resources (European Aluminium Association 2013). Technical environment and health management systems are applied prudently and sustainably by most of the semi-finished aluminium products industry. The coating process requires the use of organic and inorganic solvents. Solvent vapours are thermally utilised by means of combustion at the plant location. No measures over and beyond the statutory requirements are demanded for the manufacture of aluminium composite panels.

Sound insulation:
Sound insulation improved by up to 12 dB can be achieved on a cellular concrete wall 200 mm thick with Rw,R = 44 dB using a back-ventilated facade with 12 cm fibre insulation and panelling featuring 4 mm aluminium composite panels (as per EN ISO 10140-1). Damping behaviour (e.g. drumming noises caused by driving rain) is 5 to 10 times better than when using comparable solid aluminium sheeting (as per EN ISO 6721-1).

2.9 Product processing / Installation

Aluminium composite panels are cut to format using circular saws. For folding, the composite panels V-shaped grooves are milled using conventional woodworking machinery. Edges are formed manually. Cutting edges do not require sealing as the material is ductile. No specific environmental protection measures are required while processing aluminium composite panels. The General Information on Industrial Safety and Health (BGI 5081) applies.

2.10 Packaging

PE foils, wooden pallets and plastic tape are used as packaging materials. After use, packaging materials can be re-used or recycled. Wooden pallets, plastic and paper can be collected separately and directed to the recycling circuit.

2.11 Condition of use

The product remains unchanged during its use phase. When the product is used as designated, no changes in material composition are to be anticipated during processing or use.

2.12 Environment and health during use

When the aluminium composite panels are used as designated, no interactions between the environment and health are known.

2.13 Reference service life

The service life for many aluminium applications in the construction sector is often determined by the service life of the building. Maintenance is low thanks to the self-passivating surface. When used as designated, a service life of more than 70 years can be assumed.

2.14 Extraordinary effects

Fire
Building material class to EN 13501-1
· non-combustible A2, s1, d0 verifiably without toxic flue gases
· flame-retardant, B, s1, d0
· normal flammability D/E
Fire-retardant core materials with flame- and smoke-retardant effect

Water
The surfaces are inert and do not flush out any or only insignificant volumes of hazardous contents even in a "worst-case scenario" (ECN-X--11-089). Aluminium

composite panels do not therefore represent any hazard for soil, surface or groundwater in accordance with the EU Construction Products Directive (89/106/EC).

Mechanical destruction
In the event of mechanical destruction, all substances remain bound.

2.15 Re-use phase
De-construction: Depending on the mounting system, the facade elements and smooth panels can be removed non-destructively by unscrewing or opening the studs.
Re-use and recycling
In undamaged form, the de-constructed products can be re-used in accordance with their original designated purpose.
When separated by type, the elements can be shredded, for example, and the aluminium and core recycled after treatment.
In the event of pure aluminium recycling, the core material supports the melting process.

2.16 Disposal
There is no specific waste code for composite aluminium panels from de-construction in accordance with the European Waste Catalogue. Allocation in accordance with EWC 17 09 04 is possible.
Aluminium composite panels are accepted by scrap dealers on the basis of the respective daily aluminium scrap prices.

2.17 Further information
More information available at:
www.aluinfo.de

3. LCA: Calculation rules

3.1 Declared unit
The declared unit refers to 1 m² average aluminium composite sheet with a thickness of 4 mm and a weight of 7.04 kg.
The average is based on 5 products from two manufacturers.

Declared unit

Description	Value	Unit
Declared unit	1	m^2
Conversion factor to 1 kg	0.142	-

3.2 System boundary
Type of EPD: Cradle to gate - with options
This Life Cycle Assessment takes consideration of the life cycle stages of Production and End of Life (EoL).
The product stage comprises Modules A1 (Raw material supply), A2 (Transport) and A3 (Production).
Module D depicts the credits from the re-use, recovery and recycling potential in accordance with EN 15804.

3.3 Estimates and assumptions
It was assumed that the composite panels are directed to aluminium recycling after the use phase. A credit is only provided for the metal content; no credits are supplied for the core material.
The data set from the EPD Coil-Coated Aluminium Sheet with the Declaration number EPD-GDA-20130259-IBG1-DE was applied.

3.4 Cut-off criteria
All operating data was taken into consideration in the analysis. Processes whose entire contribution towards the final manufacturing result in terms of mass and less than 1% of all impact categories considered were ignored.
It can be assumed that the processes ignored would each have contributed less than 5% to the impact categories under review.

3.5 Background data
GaBi 6 2013 - the software system for comprehensive analysis developed by PE International (GaBi 6) – was used for modelling the life cycle for the manufacture of bright aluminium sheet. The consistent data sets contained in the GaBi data base are documented and can be viewed online (GaBi 6 2013D). The basic data in the GaBi data base was applied for energy, transport and consumables. The Life Cycle Assessment was drawn up for Germany and France as a reference area. This means that apart from the production processes under these marginal conditions, the pre-stages also of relevance for Germany and France such as provision of electricity or energy carriers were used. The power mix for Germany and France for the reference year 2009 is applied.

3.6 Data quality
The data collated by the GDA members for the production year 2011/2012 was used for modelling the product stage of composite panels. All other relevant background data sets were taken from the GaBi 6 software data base and are less than 5 years old.

3.7 Period under review
The data for this Life Cycle Assessment is based on data sets from 2011. The period of review involves 12 months for one company and 6 months for the other one.

3.8 Allocation
Of the aluminium scrap incurred in the system during production and end-of-life, the requisite volume of recycled aluminium is redirected to production. If only primary aluminium is used in product manufacturing or more scrap is incurred than can be redirected to recycling, it is assumed that these scrap values have reached end-of-waste status. A credit is supplied with primary material minus the expenses associated with remelting. This credit (substitution of primary material) is allocated to Module D taking consideration of a recovery rate (collection rate of 98%) and processing losses (4%).

3.9 Comparability
As a general rule, a comparison or evaluation of EPD data is only possible when all of the data to be compared has been drawn up in accordance with DIN EN 15804 and the building context or product-specific characteristics are taken into consideration.

4. LCA: Scenarios and additional technical information

Modules A4, A5, B1-B7 and C1-C4 are not taken into consideration in this Declaration.
Credits are incurred as a result of 100% recyclability of aluminium and are indicated in Module D. After waste collection (a 98% collection rate was assumed), the aluminium scrap is melted (remelting losses of approx. 7%) and can be re-used as recycled material. The value of the credit after remelting was calculated on the basis of the data set for primary production.

5. LCA: Results

SYSTEM BOUNDARIES (X = INCLUDED IN THE LCA; MND = MODULE NOT DECLARED)

Product stage			Construction process stage		Use stage							End-of-life stage				Benefits and loads beyond the system boundary
Raw material supply	Transport	Production	Transport	Assembly	Use / Application	Maintenance	Repairs	Replacement	Refurbishment	Operational energy use	Operational water use	De-construction	Transport	Waste treatment	Landfilling	Re-use, recovery or 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	MND	X

LCA RESULTS – ENVIRONMENTAL IMPACT: 1m²

Parameter	Unit	A1 - A3	D
Global Warming Potential	[kg CO_2 equiv.]	3.7E+1	-2.4E+1
Ozone Depletion Potential	[kg CFC11 equiv.]	8.1E-7	-7.4E-7
Acidification Potential	[kg SO_2 equiv.]	1.7E-1	-1.4E-1
Eutrification Potential	[kg $(PO_4)^3$ equiv.]	1.0E-2	-7.1E-3
Photochemical Ozone Creation Potential	[kg ethene equiv.]	1.2E-2	-7.9E-3
Abiotic Depletion Potential non-Fossil Resources	[kg Sb equiv.]	2.1E-5	-1.3E-5
Abiotic Depletion Potential Fossil Fuels	[MJ]	5.5E+2	-2.6E+2

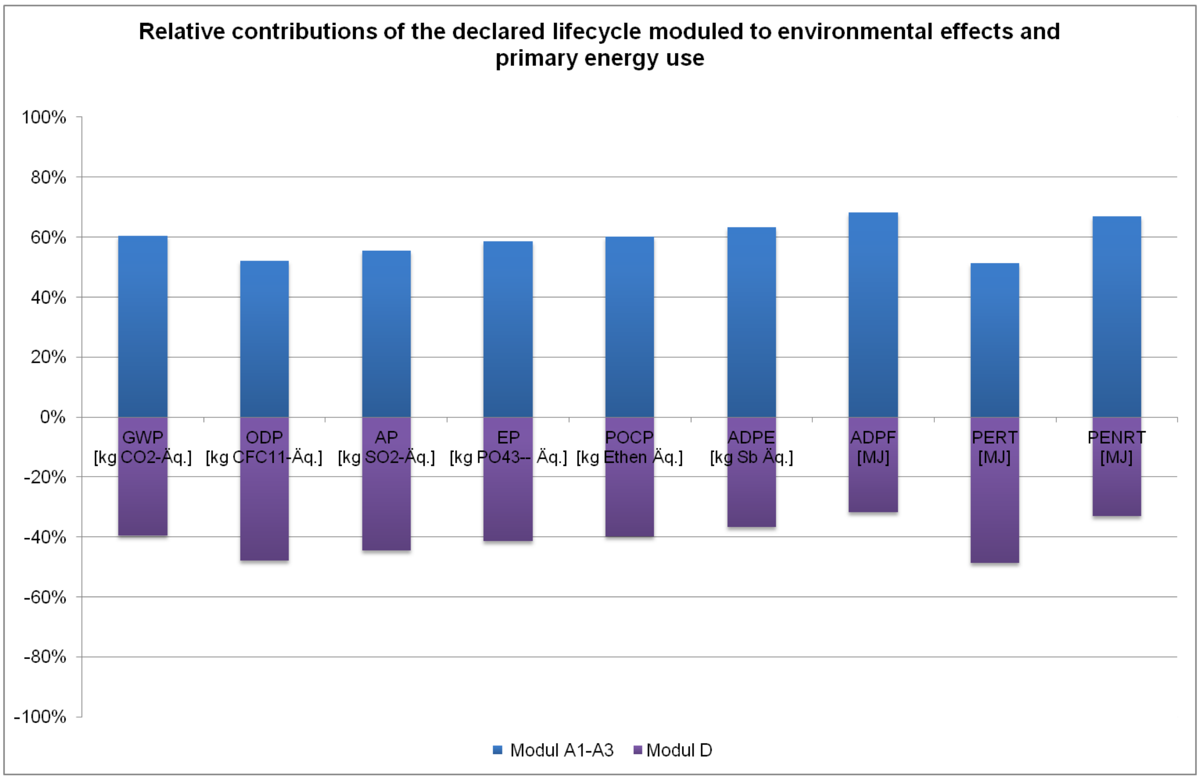
LCA RESULTS – USE OF RESOURCES: 1m²

Parameter	Unit	A1 - A3	D
Renewable primary energy as energy carrier	[MJ]	1.4E+2	-1.3E+2
Renewable primary energy as material utilisation	[MJ]	0.0E+0	0.0E+0
Total use of renewable primary energy sources	[MJ]	1.4E+2	-1.3E+2
Non-renewable primary energy as energy carrier	[MJ]	6.0E+2	-3.0E+2
Non-renewable primary energy as material utilisation	[MJ]	2.0E+1	0.0E+0
Total use of non-renewable primary energy sources	[MJ]	6.2E+2	-3.0E+2
Use of secondary materials	[kg]	0.0E+0	-
Renewable secondary fuels	[MJ]	1.8E-2	-1.6E-2
Non-renewable secondary fuels	[MJ]	1.7E-1	-1.4E-1
Net use of fresh water	[m³]	4.0E-1	-3.7E-1

LCA RESULTS – OUTPUT FLOWS AND WASTE CATEGORIES: 1m²

Parameter	Unit	A1 - A3	D
Hazardous waste for disposal	[kg]	3.1E-2	-2.0E-2
Disposed of, non-hazardous waste	[kg]	7.2E+0	-6.8E+0
Disposed of, radioactive waste	[kg]	2.7E-2	-2.0E-2
Components for re-use	[kg]	-	-
Materials for recycling	[kg]	-	6.9E+0
Materials for energy recovery	[kg]	-	-
Exported electrical energy	[MJ]	-	-
Exported thermal energy	[MJ]	-	-

6. LCA: Interpretation



Distribution of the environmental impacts in Modules A1, A2, A3 and D indicates that the contributions from Module A1 (raw materials) are the dominating ones. The credits in Module D are only attributable to recycling the aluminium scrap.

The greatest contribution to the **Global Warming Potential (GWP, 100 years)** is made by the supply of preliminary products (approx. 89%) - largely through manufacture of the aluminium sheet (approx. 88%) and core material (approx. 12%). The rest (approx. 11%) is caused by the provision of auxiliaries and the actual composite panel process step. All in all, approx. 65% of all GWP emissions are credited by recycling the aluminium at the end of life.

The **Ozone Depletion Potential (ODP)** is dominated by the provision of preliminary products (aluminium sheet approx. 99.9%). A total of 91% of all ODP emissions are credited by recycling the aluminium.

Approx. 86% of all emissions during the production stage causing the **Acidification Potential (AP)** are triggered by the aluminium sheet. 9% are attributable to the core material in the composite panels. A credit of approx. 82% of total AP emissions is offset primarily by recycling the aluminium.

The greatest contribution to the **Eutrification Potential (EP)** is made by aluminium sheet as a preliminary product (approx. 79%) and the core material (approx. 11%). Another 9% is caused by manufacturing of the actual composite sheets. Raw material transport (Module A2) accounts for 1%. In all, approx. 71% of all emissions are credited.

The **Photochemical Ozone Creation Potential (POCP)** is triggered by the provision of preliminary products (approx. 93%). These involve aluminium sheet (approx. 80%) and core material (approx. 11%). Credits account for approx. 66% here.

The **abiotic consumption of resources (ADP elementary)** is caused by the product stage (Modules A1-A3) where primarily the upstream chains from A1 (approx. 99%) (aluminium sheet approx. 72% and core material approx. 28%) contribute to overall ADP elementary. Total credits account for approx. 58%.

The **abiotic consumption of resources (ADP fossil)** is primarily the result of contributions made by the upstream chains in Module A1. Production of aluminium sheet (approx. 78%) and core material (approx. 34%) also make a contribution. A credit of approx. 62% is largely attributable to aluminium recycling.

Approx. 71% of **total primary energy requirements** is covered by non-renewable energy sources and approx. 19% by renewable energies.

The **total use of renewable primary energy sources (PERT)** is largely the result of the upstream chains associated with manufacturing preliminary products (Module A1), whereby the influence of aluminium sheet production is particularly apparent at approx. 97%. The credit (Module D) accounts for a total of approx. 93% which is attributable to aluminium recycling.

In an analysis of the **total non-renewable primary energy requirements (PENRT)**, the upstream chains associated with manufacturing preliminary products (approx. 87%) make the main contribution with approx. 70% attributable to the production of aluminium sheet and approx. 13% attributable to production of the composite core material. 15% of the total PENRT is caused by manufacturing of the actual composite panels. All in all, approx. 50% is credited; credits are primarily attributable to recycling the metallic preliminary products.

7. Requisite evidence

Roof and facade product weathering is subject to several influential factors.
Apart from the alloy and type of surface coating, other influential factors also include the environment (industry, sea etc.) and regional weather conditions as well as prevailing environmental conditions.
Removal of the surface can only be measured specifically on the respective buildings.

8. References

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In my capacity as a public translator for the English language, duly registered, commissioned and sworn by the President of the Landgericht (Regional Court) Saarbrücken, I hereby certify the foregoing to be a true and complete translation of the copy which has been submitted to me.

Marius Schütz, Theley, 26 February 2014