ENVIRONMENTAL PRODUCT DECLARATION

in accordance with ISO 14025 and EN 15804

Declaration holder	Gesamtverband der Aluminiumindustrie e.V. (German Aluminium Association GDA)
Publisher	Institut Bauen und Umwelt e.V. (IBU)
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Cold-formed aluminium sheet for exterior applications

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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GESAMTVERBAND DER ALUMINIUMINDUSTRIE e.V.

1. General information

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

Programme holder

IBU – Institut Bauen und Umwelt e.V.
Panoramastr. 1
10178 Berlin
Germany

Declaration number

EPD-GDA-20130260-IBG1-EN

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))

Issue date

18.11.2013

Valid until

17.11.2018

Prof. Dr.-Ing. Horst J. Bossenmayer
(President of Institut Bauen und Umwelt e.V.)

Dr.-Ing. Burkhart Lehmann
(Managing Director IBU)

Cold-formed aluminium sheet for exterior applications

Owner of the Declaration

Gesamtverband der Aluminiumindustrie e.V. (German Aluminium Association GDA)
Am Bonneshof 5
40474 Düsseldorf
Germany

Declared product/unit

1 kg cold-formed aluminium sheet

Area of applicability:

This document refers to the manufacture of 1 kg cold-formed aluminium sheet. This sample EPD is based on a manufacturer's representative aluminium application made of thin metal sheet for exterior applications. 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. Liability by IBU concerning manufacturer's information, LCA data and evidence is excluded.

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

Matthias Schulz
(Independent verifier appointed by the SVA)

2. Product

2.1 Product description

Cold-formed aluminium applications include small formats, standing seam systems, facade panels and roof drainage systems as well as the corresponding accessories. These involve pressed and edged individual elements made of aluminium alloys. The individual elements are bonded by overlapping and/or round fitted seams to form rainproof roof and facade cladding (depending on the product variant).

Small format:
Small formats are defined as roof or facade applications industrially manufactured from thin aluminium sheets: roof tiles, roof shingles, rhomboid roof panels, FX.12, wall shingles, 20 x 20 and 29 x 29 cm rhomboid wall panels.

Standing seam system:
Manually-produced aluminium standing seam systems are roof and facade systems made of thin metal sheets.

Facade panel:
Facade panels involve roll-formed aluminium panels. The panels are available in various widths and lengths and are used on facades, whereby the elements are bonded to form facade cladding by means of tongue-and-groove connections.

Roof drainage system:
The aluminium roof drainage system comprises gutters, pipes and the corresponding accessories. All of the system components largely comprise aluminium. The representative product was selected after an analysis of three different products supplied by the manufacturer.

2.2 Application

Small formats are used as roof and facade cladding.
Facade systems are applied as facade cladding.
Manually-produced aluminium standing seam systems are mounted as roof and facade cladding.
Roof drainage systems serve towards draining roof areas.

2.3 Technical data

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

Construction data

Description	Value	Unit
Bulk density as per DIN 1306:	2700	kg/m^3
Melting point as per Kammer 2009	660	°C
Electrical conductivity at 20 °C as per Kammer 2009	37.7	m/Ωmm^2

Thermal conductivity to EN ISO 7345	235	W/(mK)
Linear thermal expansion rate to EN ISO 6892-1	23.1	$10^{-6}K^{-1}$
Elasticity module to EN ISO 6892-1	70000	N/mm^2
Specific thermal capacity to EN ISO 7345	0.9	kJ/kgK
Yield strength Rp 0.2 min. to EN ISO 6892-1	35 - 250	N/mm^2
Tensile strength Rm min. to EN ISO 6892-1	100 - 350	N/mm^2
Elongation at break A5 min.	1 - 30	%

Alloys to EN 507 and EN 1396

2.4 Placing on the market / Application rules

- Small format:
  DIN EN 14783
  EN 14782
- Manually-produced standing seam system:
  EN 14783
- Facade cladding:
  EN 14782
- Roof drainage:
  EN 612
  EN 1462

2.5 Delivery status

Small format packaging:
On Euro pallets (120 x 80 cm)
Tiles/box, each measuring approx. 68.5 x 29 x 50 cm
Shingles/box each measuring approx. 38 x 61 x 25 cm
Rhomboid panels/box each measuring approx. 42 x 41 x 39 cm

Facade packaging:
In continuous boxes on wooden pallets (< 6 m)

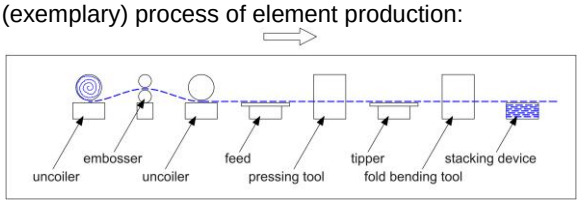
Roof drainage system packaging:
Gutter bundles in various iron frames
Pipes/box, 3050 x 295 x 460 mm
(gutters and pipes with polyethylene foil)

2.6 Base materials / Auxiliaries

The most significant base material is aluminium which is extracted from bauxite via electrolysis or by recycling aluminium scrap. Alloy elements such as various concentrations of silicon, iron, magnesium and zinc are used as additional base materials. The aluminium content of end products exceeds 90%. Typical aluminium alloys for the construction sector comply with the 3000 and 5000 series to DIN EN 573-3. Alloy-specific synthetic and mineral oil emulsions with an approx. water content of 90% are used as auxiliaries during the rolling process. These emulsions are managed in a closed loop.

2.7 Production

The colour-coated aluminium strips supplied as preliminary products (see EPD Coil-Coated Aluminium Sheet No. EPD-GDA-20130259-IBG1-DE) are clamped in coils of defined width and max. 1600 mm diameter to a decoiler and directed to the production line.
Example: Manufacturing process for PREFA roof tiles: If necessary, sheet strips are formed using an embossing roller for stucco embossing. The pulsed defined lengths are achieved via a pneumatic cycle feed. When cutting to length, the cutting outlines are also punched and in some cases attributed functional stamps. Blanks reach a turning mechanism via a conveyor belt and turning is followed by production in the hemming bending machine. The roof tiles are then placed in temporary storage for packaging in the corresponding quantities.
PREFA roof shingles or rhomboid roof panels are produced on a similar line to roof tiles. Schematic (exemplary) process of element production:



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. No particular environmental impacts arise during the production of cold-formed aluminium sheet as no thermal processes take place, for example. Any residue incurred (oil) is collected in the plant and recycled thermally externally. No measures exceeding statutory requirements are necessitated.

2.9 Product processing / Installation

The products are sold to commercial enterprises availing of the requisite tools (e.g. roofing tools) and expertise for processing these products correctly. Various accessories can be used during installation (e.g. ridge ventilators, snow guards or gable strips). No specific environmental protection measures are required when handling cold-formed aluminium sheet. The General Information on Industrial Safety and Health (BGI 5081) applies.

2.10 Packaging

Boxes, wrapping foil, polyethylene foil, euro pallets and wooden pallets are used as packaging. 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 condition of use of material supplied as semi-finished products depends on previous processing by the metalworking and installation facilities. 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 cold-formed aluminium sheet is 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
Aluminium and aluminium alloys comply with construction product class A1 in accordance with DIN 4102 and DIN EN 13501 as well as Directive 96/603/EC, and do not therefore make any contribution to fire.

Water
No environmental impact is known in the event of unforeseen exposure of aluminium sheet to water. The actual product is not sensitive to water.

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

2.15 Re-use phase

The product is not intended for re-use. The material is fully recyclable. After use, the product can be directed to a specialist company for aluminium recycling. Material produced by the recyclers can be used again as primary material. A current survey by the European Aluminium Association has established an average recycling rate of more than 95% for aluminium applications in the construction sector.

2.16 Disposal

Aluminium scrap as construction applications is a key raw material for future aluminium supplies. The recycling infrastructure is established and available world-wide.
The waste code for aluminium in accordance with the European Waste Catalogue (EWC) is 17 04 02.

2.17 Further information

More information available at:
www.aluinfo.de

3. LCA: Calculation rules

3.1 Declared unit

The declared unit involves 1 kg cold-formed aluminium sheet.
The representative product was selected after an analysis of three different products supplied by the manufacturer.

Declared unit

Description	Value	Unit
Declared unit	1	kg
Conversion factor to 1 kg	1	-

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

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 – was used for modelling the life cycle for the manufacture of cold-formed aluminium sheet. The consistent data sets contained in the GaBi data base are documented and can be viewed online (GaBi 6). The basic data in the GaBi data base was applied for energy, transport and consumables. The Life Cycle Assessment was drawn up for Austria as a reference area. This means that apart from the production processes, the pre-stages also of relevance for Austria such as provision of electricity or energy sources were used. The power mix largely comprising hydro-power from reference year 2009 is applied.

3.6 Data quality

The data collated by the GDA member for the production year 2011 was used for modelling the product stage of cold-formed aluminium sheet. 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 under review was 12 months.

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 96%) 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 96% 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: 1kg

Parameter	Unit	A1 - A3	D
Global Warming Potential	[kg CO_2 equiv.]	1.1E+1	-7.9E+0
Ozone Depletion Potential	[kg CFC11 equiv.]	3.0E-7	-2.4E-7
Acidification Potential	[kg SO_2 equiv.]	5.7E-2	-4.4E-2
Eutrification Potential	[kg $(PO_4)^{3-}$ equiv.]	3.1E-3	-2.3E-3
Photochemical Ozone Creation Potential	[kg ethene equiv.]	3.4E-3	-2.5E-3
Abiotic Depletion Potential non-Fossil Resources	[kg Sb equiv.]	5.9E-6	-4.0E-6
Abiotic Depletion Potential Fossil Fuels	[MJ]	1.3E+2	-8.2E+1

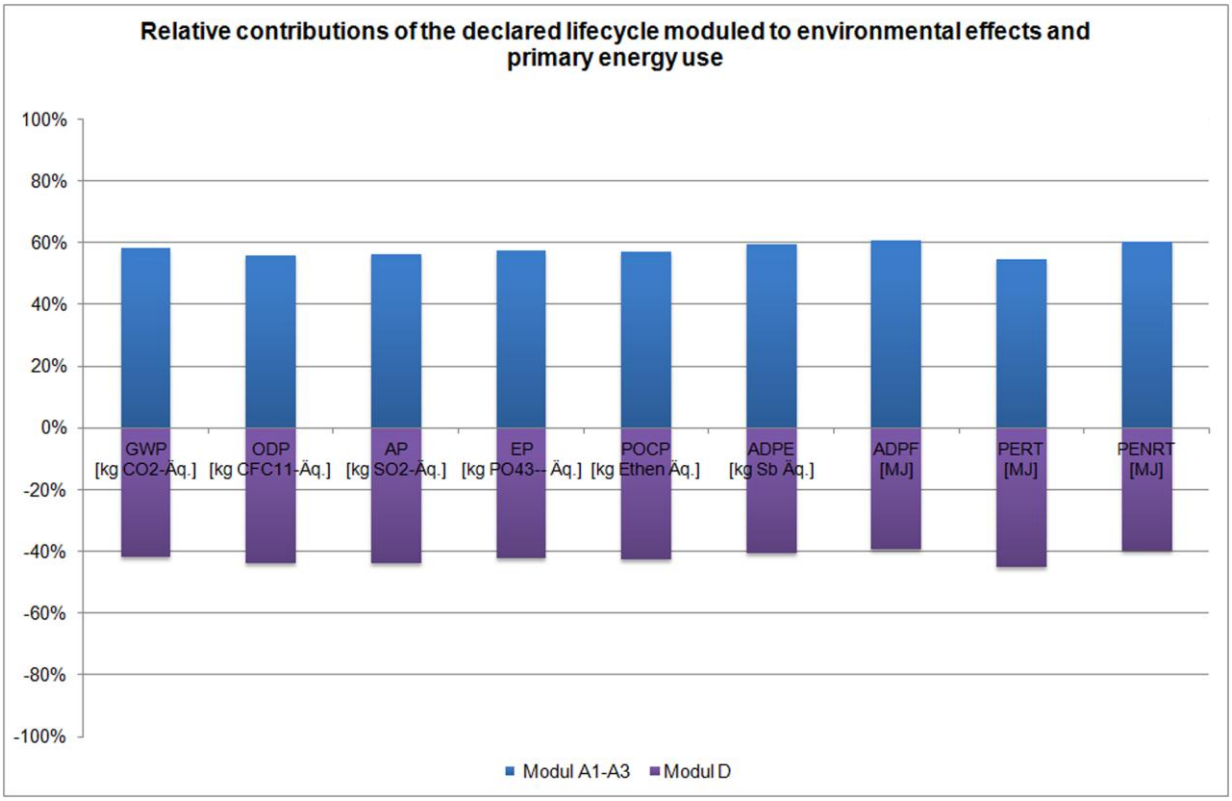
LCA RESULTS – USE OF RESOURCES: 1kg

Parameter	Unit	A1 - A3	D
Renewable primary energy as energy carrier	[MJ]	5.2E+1	-4.3E+1
Renewable primary energy as material utilisation	[MJ]	0.0E+0	0.0E+0
Total use of renewable primary energy sources	[MJ]	5.2E+1	-4.3E+1
Non-renewable primary energy as energy carrier	[MJ]	1.5E+2	-9.8E+1
Non-renewable primary energy as material utilisation	[MJ]	0.0E+0	0.0E+0
Total use of non-renewable primary energy sources	[MJ]	1.5E+2	-9.8E+1
Use of secondary materials	[kg]	0.0E+0	-
Renewable secondary fuels	[MJ]	5.8E-2	-5.0E-3
Non-renewable secondary fuels	[MJ]	5.9E-2	-4.6E-2
Net use of fresh water	[m^3]	1.4E-1	-1.2E-1

LCA RESULTS – OUTPUT FLOWS AND WASTE CATEGORIES: 1kg

Parameter	Unit	A1 - A3	D
Hazardous waste for disposal	[kg]	1.0E-2	-6.5E-3
Disposed of, non-hazardous waste	[kg]	2.7E+0	-2.2E+0
Disposed of, radioactive waste	[kg]	9.4E-3	-6.5E-3
Components for re-use	[kg]	0.0E+0	0.0E+0
Materials for recycling	[kg]	0.0E+0	-9.6E-1
Materials for energy recovery	[kg]	0.0E+0	0.0E+0
Exported electrical energy	[MJ]	0.0E+0	0.0E+0
Exported thermal energy	[MJ]	0.0E+0	0.0E+0

6. LCA: Interpretation



The greatest contribution to the **Global Warming Potential (GWP, 100 years)** is made by the supply of preliminary products (approx. 99%) - largely through manufacture of the coil-coated aluminium sheet (approx. 98%) and aluminium tape (approx. 1%). The rest (approx. 1%) is caused by the provision of auxiliaries and the actual cold-forming process step. All in all, approx. 79% of all GWP emissions are credited by recycling the aluminium at the end of life. 3% of all credits are attributable to recycling the aluminium from the production stage.

The **Ozone Depletion Potential (ODP)** is dominated by the provision of preliminary products (coil-coated aluminium sheet approx. 99.9%). A total of 86% of all ODP emissions are credited by recycling the aluminium.

Approx. 98% of the **Acidification Potential (AP)** is triggered by the provision of raw materials for coil-coated aluminium sheet during the production stage. A credit of approx. 85% of total AP emissions is offset primarily by recycling the aluminium.

The greatest contribution to the **Eutrification Potential (EP)** is made by the production of coil-coated aluminium sheet (approx. 97%). Production of aluminium tape and transporting the coil-coated aluminium sheet each account for 1%. In all, approx. 79% of all emissions are credited.

The **Photochemical Ozone Creation Potential (POCP)** is triggered by the provision of preliminary products. These involve coil-coated aluminium sheet (approx. 99%) and aluminium tape (approx. 1%). Credits account for approx. 81% here.

The **abiotic consumption of resources (ADP elementary)** is largely caused by the product stage (Modules A1-A3) where primarily the upstream chains from A1 (coil-coated aluminium sheet approx. 98%, aluminium tape approx. 1% and transport of coil-coated aluminium sheet approx. 1%) contribute to overall ADP elementary. Total credits account for approx. 73%.

The **abiotic consumption of resources (ADP fossil)** is primarily the result of contributions made by the upstream chains in Module A1 (production of coil-coated aluminium sheet (approx. 98%), production of the aluminium tape (approx. 1%), transport (approx. 1%)). A credit of approx. 68% is largely attributable to aluminium recycling.

Approx. 77% of **total primary energy requirements** is covered by non-renewable energy sources and approx. 23% 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 production of the coil-coated aluminium sheet is particularly apparent accounting for approx. 98%, production of the aluminium tape accounting for approx. 1% and the use of electrical energy during the cold-forming process also accounting for approx. 1%. The credit (Module D) accounts for a total of approx. 90% and is attributable to aluminium recycling.

In an analysis of the **total non-renewable primary energy sources (PENRT)**, the upstream chains associated with production of the preliminary products make the main contribution: 98% is incurred by the production of coil-coated aluminium sheet, approx. 1% by production of the aluminium tape and approx. 1% by transporting the coil-coated aluminium sheet. All in all, approx. 70% is credited, primarily attributable to recycling the aluminium.

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

BGI 5081: 2012-07, Component Booklet, Industrial Safety and Health at Work, Professional association for the building industry, Berlin

DIN 1306:1984-06, Density, concepts, presentation of values

DIN 4102:1998-05, Fire performance of building materials and components

DIN EN 13501-1:2010-01, Fire classification of construction products and building elements - Part 1: Classification using data from reaction to fire tests

DIN EN 14783:2013-07, Fully-supported metal sheet and strip for roofing, external cladding and internal lining – Product specification and requirements

EN 507:2000-01, Roofing products from metal sheet – Specification for fully-supported roofing products of aluminium sheet

EN 573-3: 2009-08, Aluminium and aluminium alloys – Chemical composition and form of wrought products – Part 3: Chemical composition and form of products

EN 612:2005-04, Eaves gutters with bead-stiffened fronts and rainwater pipes with seamed joints made of metal sheet

EN 1396:2007-04, Aluminium and aluminium alloys – Coil-coated sheet and strip for general applications – Specifications

EN 1462:2004-12, Brackets for eaves gutters – Requirements and testing

EN 14782:2006-03, Self-supporting metal sheet for roofing, external cladding and internal lining – Product specification and requirements

EN ISO 6892-1:2009-12, Metallic materials – Tensile testing – Part 1: Method of test at room temperature

EN ISO 7345:1996-01, Thermal insulation – Physical quantities and definitions

GaBi 6 2013: PE INTERNATIONAL AG; GaBi 6: Software system and data base for comprehensive analysis. Copyright TM. Stuttgart, Echterdingen, 1992-2013

GaBi 6 2013D: GaBi 6: GaBi 6 documentation: data sets in the data base for comprehensive analysis. Copyright TM. Stuttgart, Echterdingen, 1992-2013. http://documentation.gabi-software.com/

European Aluminium Association, 2013-04, Environmental Profile Report for the European Aluminium Industry, http://www.alueurope.eu/wp-content/uploads/2011/10/Environmental-Profile-Report-for-the-European-Aluminium-Industry-April-2013.pdf

Kammer 2009: Aluminium Taschenbuch 2009, 16th print run, Dr.-Ing. C. Kammer, Aluminium-Verlag Marketing und Kommunikation GmbH, Düsseldorf

Commission **Directive 96/603/EC** dated 4 October 1996 for specifying a directory of products to be classified as category A "No contribution to fire" in accordance with the Council decision 94/611/EC on construction products for implementing Article 20 of Directive 89/106/EEC

Institut Bauen und Umwelt e.V., Berlin (pub.):

General Principles for the EPD range of Institut Bauen und Umwelt e.V. (IBU), 2013-04

Product Category Rules for Construction Products, Part A: Calculation Rules for the Life Cycle Assessment and Requirements on the Background Report, 2013-04

DIN EN ISO 14025:2011-10, Environmental labels and declarations – Type III environmental declarations – Principles and procedures

EN 15804:2012-04, Sustainability of construction works – Environmental product declarations – Core rules for the product category of construction products

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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