Environmental Product Declaration

In accordance with ISO 14025:2006 and EN 15804:2012+A2:2019 for:

Pre-coated Aluminium (Pre-coated AL)

from

KG Steel

Programme:	The International EPD® System, www.environdec.com
Programme operator:	EPD International AB
EPD registration number:	S-P-06915
Publication date:	2022-10-17
Revision date	2023-11-17
Valid until:	2027-09-10

General information

Programme information

Programme:	The International EPD® System
Address:	EPD International AB Box 210 60 SE-100 31 Stockholm Sweden
Website:	www.environdec.com
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Accountabilities for PCR, LCA and independent, third-party verification
Product Category Rules (PCR)
CEN standard EN 15804 serves as the Core Product Category Rules (PCR)
Product Category Rules (PCR): Construction products 2019:14, version 1.11
UN CPC code: 412 Products of iron or steel
PCR review was conducted by: *<name and organisation of the review chair, and information on how to contact the chair through the programme operator>*
Life Cycle Assessment (LCA)
LCA accountability: Hyochan Jo G.M(General Manager), KG Steel
Third-party verification
Independent third-party verification of the declaration and data, according to ISO 14025:2006, via: ☒ EPD verification by individual verifier Third-party verifier: *<name, organisation, and signature of the third-party verifier>* Approved by: The International EPD® System
Procedure for follow-up of data during EPD validity involves third party verifier: ☒ Yes ☐ No

The EPD owner has the sole ownership, liability, and responsibility for the EPD.

EPDs within the same product category but from different programmes may not be comparable. EPDs of construction products may not be comparable if they do not comply with EN 15804. For further information about comparability, see EN 15804 and ISO 14025.

Company information

Owner of the EPD:

- Name: KG Steel

- Phone: +82-2-3450-8114

- Address: 416, Hangang-daero, Jung-gu, Seoul, Republic of Korea

- Contact: Hyochan Jo G.M (General Manager), hcjo@kggroup.co.kr

Description of the organisation:

In 1967, KG Steel was the first company in Korea to produce cold-rolled steel (CR) sheets. Since then, we have been selling many types of steel products at more than 2.4 million tons annually, including CR Steel, Galvanized Steel, Pre-painted Steel and Electrolytic Plating Products through our Dangjin Works and Incheon Works. Since 1999, We boast the world's highest competitiveness following the completion of the Dangjin Works, which has completely automated the entire manufacturing process, from raw material input to product output, a first in the world steel industry.

In 2019, KG Steel welcomed another chance to take a leap forward under the value of “A respected company, A proud Company” as a new member of KG Family. In the future, we will maximize the value for our customers and shareholders through continuous financial structure improvement, facility investment, and product development. We will also be reborn as a steel company that represents the Korean economy by expanding social responsibility and strengthening industrial competitiveness

Product-related or management system-related certifications: EMAS-registrations, SA 8000, supply chain management and social responsibility.

KG Steel is fulfilling its social responsibilities as a company by continuously researching eco-friendly production In 1996, the Incheon works was designated as an eco-friendly company and ISO 14001 and ISO 9001 were introduced throughout the company by 2002. In addition, it won the first place from Global Green Management Excellence Awards in 2007. And it was selected as the only Awards Named Green Business among Korean steel companies in 2010 and was designated for 6 consecutive times until 2016.

By participating in the national LCI DB construction project in 2022, we are continuing to manage to meet the global trend related to the environment. In particular, we are currently renting roofs to Dangjin Works as a space for solar power generation of local power plants. In 2023, we are conducting NetZero consulting with government agencies to invest in 4400kw of Incheon Works and 2700kw of Dangjin Works and to invest in inverter installation to reduce power consumption of plating pot facilities.

Name and location of production sites: Republic of Korea

- Dangjin Works: 1228, Bukbusaneop-ro, Songak-eup, Dangjin-si, Chungcheongnam-do

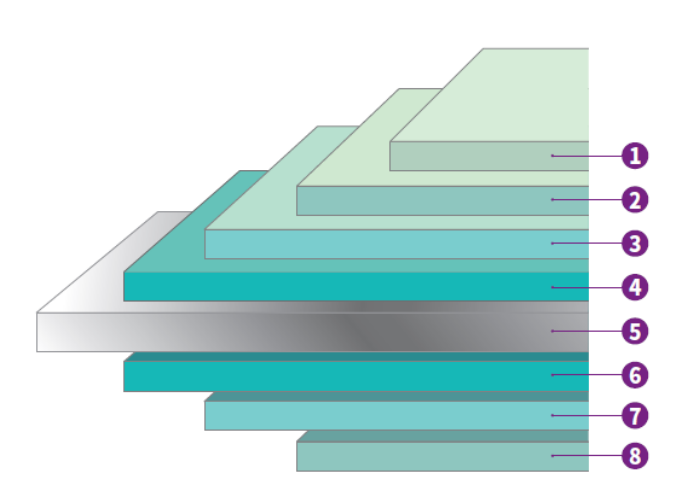
- Incheon Works: 789, Baekbeom-ro, Seo-gu, Incheon

Product information

Product name: Pre-coated Aluminium (Pre-coated AL)

Product identification

Boasting the highest value among CR products. These are pre-coated or film coated CR steel, Galvanized steel and Aluminium steel. Enable to apply in the surface of various patterns and design. And, There are various products depending on the type of paint used. The sectional structure of the color steel sheet is as follows.



1	Top (Finish) Coating
2	Primer Coating
3	Chromate Coating
4	Plating Layer (Zn, Al, 55%AL+Zn, Sn, Cr, etc.)
5	Base Metal (Cold rolled steel sheet)
6	Plating Layer (Zn, Al, 55%Al+Zn, Sn, Ct, etc.)
7	Chromate Coating
8	- Service Coating(5 ㎛) - Functional Paint (Epoxy, Polyester, etc.)

AL has a very good corrosion resistance and is different from other materials called lightweight. Pre-coated metal Al sheets are mostly used for construction, especially fluorine-painted Pre-coates metal AL sheets used as outer plates for AL composite panels are the most high value-added products. The main uses are for AL composite panels, ceiling materials, shutters, and for the outer panel of the vehicle equipped with the speciality facility for performing the special task and structure.

Characteristics

Raw Materials	Zinc Coating Weight	Quality Characteristics		
		Anti-Corrosion	Workability	Paint Ability
AL	N/A	5	5	4

※ 5 Point: Excellent, 4 Point: Good, 3 Point: Normal, 2 Point: Bad, 1 Point: Worst

Product Application: Building Materials, Auto mobile Parts, Composite panels, etc.

Other product data such as standard certificate can be downloaded from the web address as follows. https://www.kg-steel.co.kr/html/F00.support.html

Geographical scope: Republic of Korea.

Manufacturing Process

Table 1 Manufacturing process of Pre-coated AL

Process	Description
CPL and RCM	Hot coil, is placed in a hydrochloric acid tank to remove the oxidized layer on the surface and cold-rolled to ideal a thickness ordered. The process is divded into Continous Pickling Line (CPL) and Reversing Cold Mills (RCM) in Incheon Works.
CCL	Colour Coating line (CCL) is a pre-coating line that forms coats through advance application and baking of coating materials onto strips produced by Continuous Galvanizing Lines (CGL; to enhance corrosion resistance). It is an add-on for visual aspects of strips, such as color and gloss, as well as for protective elements, such as weather and corrosion resistance.

LCA information

Declared unit: 1 tonne of Pre-coated AL

Time representativeness: FY year 2021

Database(s) and LCA software used: Gabi 10 software system. Gabi database provides the life cycle inventory data for several of the raw and process materials obtained from upstream system. The database used are professional database, Full US extension database XVII.

Electricity Mix: The Korean national grid mix with the climate impact, 0.514kg CO_2/kWh, is used in this EPD study from Module A1 to A3. The dataset for electricity mix

Description of system boundaries: ″Cradle to gate with options, module C1-C4 and module D”

(A1–A3 + C + D) is selected for the LCA study according to EN 15804 Section 5.2. The detailed information for manufacturing process from Module A3 is described in the product information in Table 1.

Table 2 System boundary and Life Cycle

EPD Module	Life Cycle Stages	Definition
A1	Raw Material Supply	Extraction, production of the raw materials
A2	Transport to manufacturer	Transport raw materials to the manufacturing unit
A3	Manufacturing	- Production of ancillary materials or pre-products - Manufacturing of products and co-products - Manufacturing of Packaging
C1	De-construction demolition	deconstruction, including dismantling or demolition, of the product from the building, including initial on-site sorting of the materials
C2	Transport	transportation of the discarded product as part of the waste processing, e.g. to a recycling site and transportation of waste e.g. to final disposal.
C3	Waste processing	waste processing e.g. collection of waste fractions from the deconstruction and waste processing of material flows intended for reuse, recycling and energy recovery. Waste processing shall be modelled and the elementary flows shall be included in the inventory. Materials for energy recovery are identified based on the efficiency of energy recovery with a rate higher than 60 % without prejudice to existing legislation. Materials from which energy is recovered with an efficiency rate below 60% are not considered materials for energy recovery.
C4	Disposal	waste disposal including physical pre-treatment and management of the disposal site.

D	Reuse-Recovery-Recycling-potential	the environmental benefits or loads resulting from reusable products, recyclable materials and/or useful energy carriers leaving a product system e.g. as secondary materials or fuels.

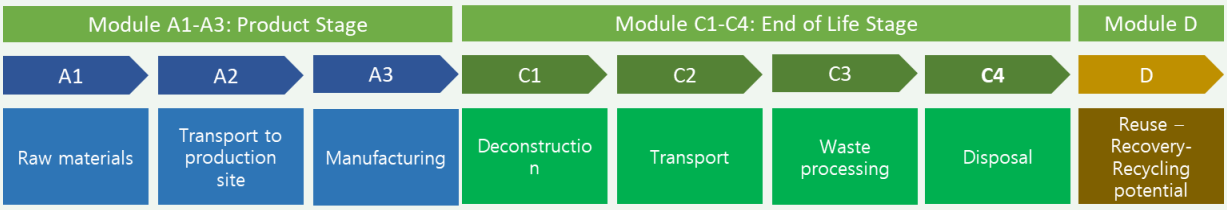


Figure 1 System boundary diagram

Excluded life cycle stages: Use phase and the end of life is not included following the PCR.

Cut-Off Rule: Criteria were set out in the original study for the recording of material flows and to avoid the need to pursue trivial inputs/outputs in the system. Life cycle inventory data shall according to EN 15804 include a minimum of 95% of total inflows (mass and energy) per module. In reality, at least 98% of material inputs to each process stage were included. Inflows not included in the LCA shall be documented in the assumptions and limitations.

Assumptions and Limitations

- Raw material: All the plating materials in the production were considered as the inflows such as zinc, chromium and paint. When calculating the mass balance between inflows and outflows per module, the contribution of the liquid materials was calculated by applying a theoretical ratio for the steel plate. The inflows of raw material excluded according to the cut-off rule are as follows; rolling oil, caustic soda, reactive liquids for surface treatment, degreasing liquid, wet oil, anti-rust oil, thinner.

- Waste: During the manufacturing stage, Module A3, the outflow does not include the waste, which is not directly related to the production. The excluded waste is the packaging of the raw material, construction wastes, wood and glass and so on. The secondary database for waste treatment was categorized into municipal waste and hazardous waste. The distance from the manufacturing plant to the place of waste treatment is set to 30km considering the site-specific data.

- Product: The steel product of KG steel is classified as Grade 1, Grade 2, Unclassed, and Scrap. The product of Class 1, Class 2, Unclassed are considered as the target product of LCA. All scraps from KG Steel are sold at a negligible price and amount. Therefore, the scrap cannot be treated as waste but co-product which need allocation.

Allocation Rules

Allocation is required if some material, energy, and waste data cannot be measured separately for the product under investigation. The allocation rule follows the PCR 2019:14 and Section 6.4.3.2 in EN15804 in the following order;

1. Allocation should be avoided.

2. Allocation should be based on physical properties (e.g. mass, volume) when the difference in revenue is small.

3. Allocation should be based on economic values.

Allocation used in Ecoinvent 3.6 environmental data sources follows the methodology 'allocation, cut-off by classification'. This methodology is in line with the requirements of the EN 15804 -standard.

- Allocation based on economic value:

Allocation shall be based on physical properties (e.g. mass, volume) when the difference in revenue from the co-products is low. However, PCR 2019:14 does not provide clear criterion for how much difference in revenue in order to

proceed economic allocation. Therefore, the EPD study adopted the criteria from UL Product Category Rules (PCR) Guidance for Building Related Products and Services Part A: Life Cycle Assessment Calculation Rules and Report Requirements. The criteria are as follows;

Unless specified otherwise in a PCR, allocation shall be based on physical properties (e.g. mass, volume) when the difference in revenue from the co-products is low. Regardless of the allocation approach chosen for a co-production process or for secondary flows crossing the system boundary between product systems, specific inherent properties of such coproducts or flows (e.g. calorific content, composition (biogenic carbon content, CaO/Ca(OH)2 content)), shall not be allocated but always reflect the physical flows. In all other cases, allocation shall be based on economic values. Contributions to the overall revenue of the order of 1% or less is regarded as very low. A difference in revenue of more than 25% is regarded as high.

Modules declared and geographical scope:

	Product stage			Construction process stage		Use stage							End of life stage				Resource recovery stage
	Raw material supply	Transport	Manufacturing	Transport	Construction installation	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	De-construction demolition	Transport	Waste processing	Disposal	Reuse-Recovery-Recycling-potential
Module	**A1**	**A2**	**A3**	**A4**	**A5**	**B1**	**B2**	**B3**	**B4**	**B5**	**B6**	**B7**	**C1**	**C2**	**C3**	**C4**	**D**
Modules declared	X	X	X	-	-	-	-	-	-	-	-	-	X	X	X	X	X
Geography	KR	KR	KR	-	-	-	-	-	-	-	-	-	GLO	GLO	GLO	GLO	GLO

X: Module declared
-: Module not declared (such a declaration shall not be regarded as an indicator of a zero result)

Scenarios for module C1-C4 and D

- De-construction demolition (C1) : Energy consumption of a demolition process is on average 10kWh/m2 (Bozdag, Ö & Seçer, M. 2007). The average mass of a reinforced concrete building is about 1000 kg/m2. Therefore, energy consumption during demolition is 10kWh per declared unit, 1 metric ton. A conservative assumption has been made that the energy consumed during demolition of a steel building is the same as that of a concrete building. The source of energy is diesel fuel used by industrial equipments.

- Transport (C2) : It is assumed that 100% of the waste is collected and transported to the waste treatment centre. Transportation distance to the waste treatment cetre is assumed as 300 km and the transportation method is assumed to be lorry, Euro 0-6 mix.

- Waste processing (C3) : Approximately 95% of steel is assumed to be recycled based on World Steel Association, 2020.

- Disposal (C4) : It is assumed that the remaining 5 % of steel is buried to landfill for final disposal.

- Reuse-Recovery-Recycling-potential (D) : During the recycling process, 95% of the end-of-life product is converted into recycled steel.

Environmental Information

The LCIA results for 1 tonne of pre-coated AL are given.

Potential environmental impact – mandatory indicators according to EN 15804

PARAMETER		UNIT	A1	A2	A3	Total A1 - A3	C1	C2	C3	C4	D
Global warming potential (GWP)	TOTAL	kg CO_2 eq.	8.59E+03	1.21E+00	6.60E+01	8.66E+03	3.67E+00	8.38E+01	8.01E+00	2.59E-01	-1.64E+03
	Fossil	kg CO_2 eq.	8.59E+03	1.19E+00	6.90E+01	8.66E+03	3.67E+00	8.20E+01	7.90E+00	2.58E-01	-1.65E+03
	Biogenic	kg CO_2 eq.	1.63E+00	1.99E-02	-3.01E+00	-1.36E+00	0	1.34E+00	8.90E-02	2.43E-04	9.73E+00
	Land use and land transfor mation	kg CO_2 eq.	1.90E+00	6.77E-03	3.62E-03	1.91E+00	0	4.74E-01	2.39E-02	2.43E-04	-2.20E-01
Ozone Depletion		kg CFC-11 eq.	7.67E-09	7.28E-14	6.06E-08	6.82E-08	2.05E-10	5.09E-12	2.60E-06	1.07E-07	2.22E-09
Acidification		Mole of H+ eq.	4.18E+01	8.32E-03	6.15E-01	4.24E+01	5.52E-02	5.82E-01	6.58E-02	2.48E-03	-4.04E+00
Eutrophication aquatic freshwater		kg P eq.	4.02E-03	3.63E-06	1.35E-04	4.16E-03	2.26E-06	2.54E-04	8.40E-04	2.41E-05	-3.84E-04
Eutrophication marine		kg N eq.	5.58E+00	4.12E-03	-2.11E-02	5.56E+00	2.22E-02	2.88E-01	2.32E-02	8.62E-04	-6.48E-01
Eutrophication terrestrial		Mole of N eq.	6.08E+01	4.56E-02	5.51E-01	6.14E+01	2.43E-01	3.19E+00	2.53E-01	9.42E-03	-5.81E+00
Formation of photochemical ozone		kg NMVOC eq.	1.73E+01	7.75E-03	1.91E-01	1.75E+01	6.47E-02	5.42E-01	7.30E-02	2.74E-03	-2.63E+00
Depletion of abiotic resources - minerals & metals		kg Sb eq.	6.41E-04	1.02E-07	2.16E-06	6.43E-04	0	7.13E-06	2.23E-05	6.01E-07	-9.34E-03
Depletion of abiotic resources - fossil		MJ	1.10E+05	1.62E+01	1.50E+03	1.12E+05	1.02E+02	1.14E+03	1.85E+02	7.38E+00	-1.64E+04
Water Use		m3 eq.	1.30E+03	1.09E-02	2.10E+00	1.31E+03	0	7.62E-01	6.62E+00	3.39E-01	-1.11E+02

Use of resources according to EN 15804

PARAMETER	UNIT	A1	A2	A3	Total A1 – A3	C1	C2	C3	C4	D
Use of renewable primary energy (PERE)	MJ	5.03E+04	9.23E-01	5.82E+01	5.03E+04	0	6.45E+01	2.29E+00	6.40E-02	6.48E+02
Primary energy resources as raw materials (PERM)	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0	0	0	0	0
Total use of renewable primary energy resources (PERT)	MJ	5.03E+04	9.23E-01	5.82E+01	5.03E+04	0	6.45E+01	2.29E+00	6.40E-02	6.48E+02
Use of non-renewable primary energy (PENRE)	MJ	1.10E+05	1.63E+01	1.50E+03	1.12E+05	1.02E+02	1.14E+03	1.85E+02	7.38E+00	-1.64E+04
Non-renewable primary energy resources used as raw materials (PENRM)	MJ	0	0	0	0	0	0	0	0	0
Total use of non-renewable primary energy resources (PENRT)	MJ	1.10E+05	1.63E+01	1.50E+03	1.12E+05	1.02E+02	1.14E+03	1.86E+02	7.39E+00	-1.64E+04
Input of secondary material (SM)	Kg	0	0	0	0	0	0	0	0	0
Use of renewable secondary fuels (RSF)	MJ	0	0	0	0	0	0	0	0	0
Use of non-renewable secondary fuels (NRSF)	MJ	0	0	0	0	0	0	0	0	0
Use of net fresh water (FW)	m3 eq.	1.23E+02	1.04E-03	1.37E+00	1.24E+02	0	7.30E-02	1.54E-01	7.88E-03	-1.67E+02

Waste production and output flows

PARAMETER	UNIT	A1	A2	A3	Total A1 – A3	C1	C2	C3	C4	D
Hazardous Waste Disposed	kg	6.76E-06	7.79E-11	4.49E-08	6.81E-06	0	5.45E-09	0	0	-1.23E-04
Non-hazardous Waste Disposed	kg	2.47E+03	2.33E-03	6.37E-01	2.47E+03	0	1.63E-01	0	0	1.99E+02
Radioactive Waste Disposed	kg	6.67E+00	2.00E-05	8.39E-02	6.76E+00	0	1.40E-03	0	0	1.80E-03
Components for Re-use	kg	0	0	0	0	0	0	0	0	0
Material for Recycling (MFR)	kg	0	0	0	0	0	0	0	0	0
Materials for Energy Recovery (MER)	kg	0	0	0	0	0	0	0	0	0
Exported Electricity Energy (EEE)	MJ	0	0	0	0	0	0	0	0	0
Exported Thermal Energy (EET)	MJ	0	0	0	0	0	0	0	0	0

Information on biogenic carbon content

Results per declared unit		
BIOGENIC CARBON CONTENT	**Unit**	**QUANTITY**
Biogenic carbon content in product	kg C	0.00E+00
Biogenic carbon content in packaging	kg C	1.17E+00

Note: 1 kg biogenic carbon is equivalent to 44/12 kg CO_2.

Differences versus previous versions:

2023-10-17 Version 1

2023-11-17 Version 1.1

Editorial change: Modules C1-C4 and D were included insystem boundary accroding to EN15804 and Environdec requirements.

References

- The International EPD® System, The International EPD® System is a programme for type III environmental declarations, maintaining a system to verify and register EPD®s as well as keeping a library of EPD®s and PCRs in accordance with ISO 14025, www.environdec.com
- Product Category Rules (PCR): Construction products 2019:14, version 1.11
- General Programme Instructions of the International EPD® System. Version 3.01.
- UL Product Category Rules (PCR) Guidance for Building Related Products and Services Part A: Life Cycle Assessment Calculation Rules and Report Requirements, UL 10010 Sixth Edition, Dated March 28, 2022
- ISO 14020:2000 Environmental labels and declarations - General principles
- ISO 14025:2006 Environmental labels and declarations - Type III environmental declarations - Principles and procedures
- ISO 14040:2006 Environmental management- Life cycle assessment - Principles and framework
- ISO 14044:2006 Environmental management - Life cycle assessment - Requirements and guidelines

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