ENVIRONMENTAL PRODUCT DECLARATION

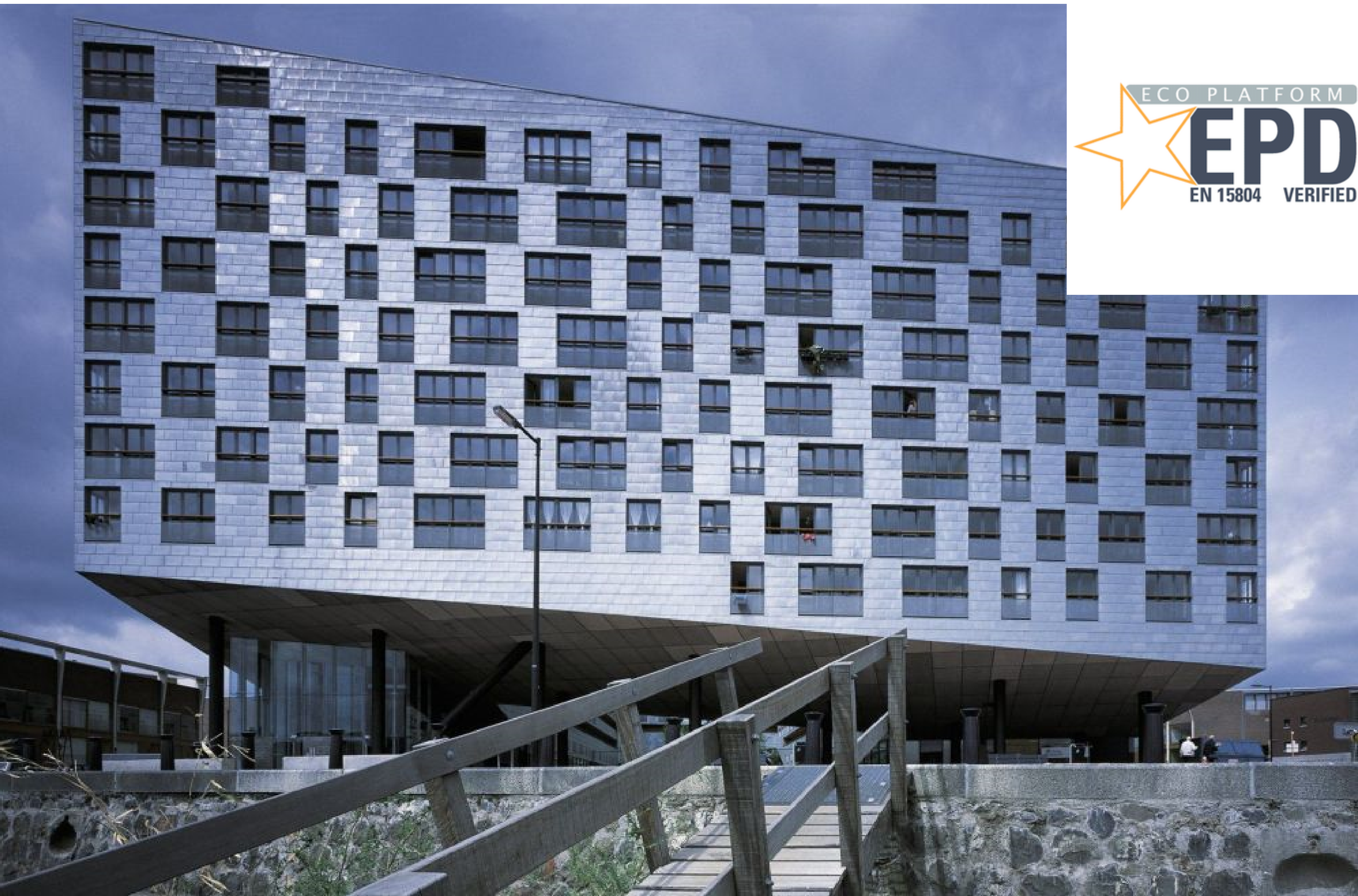
as per ISO 14025 and EN 15804

Owner of the Declaration	**NedZink B.V.**
Programme holder	Institut Bauen und Umwelt e.V. (IBU)
Publisher	Institut Bauen und Umwelt e.V. (IBU)
Declaration number	EPD-NED-20140082-IBA2-EN
ECO EPD Ref. No.	ECO-00000088
Issue date	23.10.2015
Valid to	22.10.2020

NedZink NATUREL

NedZink B.V.

www.bau-umwelt.com / https://epd-online.com



NedZink THINK ZINK

1. General Information

NedZink B.V.

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

Declaration number
EPD-NED-20140082-IBA2-EN

This Declaration is based on the Product Category Rules:
Building metals, 07.2014
(PCR tested and approved by the SVR)

Issue date
23.10.2015

Valid to
22.10.2020

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

Dr. Burkhart Lehmann
(Managing Director IBU)

NedZink NATUREL

Owner of the Declaration
NedZink B.V.
Hoofdstraat 1
6024 AA, Budel-Dorplein
Netherlands

Declared product / Declared unit
1kg NedZink® NATUREL, bright-rolled titanium zinc

Scope:
The Life Cycle Assessment (LCA) was carried out according to ISO 14040, ISO 14044 and EN 15804. The LCA is performed for NedZink® NATUREL manufactured by NedZink B.V. in Budel-Dorplein, Netherlands. NedZink B.V. has provided the site-specific data, background processes are taken from the Ecoinvent (version 2) database.

The LCA was carried out for the manufacturing phase of the declared product, containing information on raw and secondary material production, transport and packaging (cradle to gate). Possible credits after the end of life phase (module D) are also included.

The owner of the declaration shall be liable for the underlying information and evidence; the IBU shall not be liable with respect to manufacturer information, life cycle assessment data and evidences.

Verification

The CEN Norm /EN 15804/ serves as the core PCR

Independent verification of the declaration according to /ISO 14025/

☐ internally ☒ externally

Mr Carl-Otto Neven
(Independent verifier appointed by SVR)

2. Product

2.1 Product description

NedZink® NATUREL is titanium zinc produced by NedZink according to EN 988. Small quantities, as specified in EN 988, of the alloy elements copper, titanium and aluminium are added to electrolytically refined zinc (with a purity of min. 99,995% Zn, Z1 according to EN 1179). The chemical composition, mechanical and physical properties and measurement tolerances are determined in the KOMO product certificate and the product certificate from Lloyd's Register, LRIQS (Approval QIS122). The defined material properties are checked by an independent and neutral research institute. This product certification and the ISO 9001 certificate for the quality management system at NedZink assure a constant and uniform high quality standard.

2.2 Application

NedZink® NATUREL titanium zinc coils, sheets, strips and profiles are used for roof and façade cladding, interior use and rainwater drainage systems (gutters, downpipes and accessories).

NedZink® NATUREL is intended mainly for outdoor use. However, the product is safe for indoor use and can be used as such. There are no harmful emissions to indoor air. The product does not contain VOC's.

2.3 Technical Data

Constructional data

Name	Value	Unit
Coefficient of thermal expansion	22	$10^{-6}K^{-1}$
Tensile strength	≥ 150	N/mm^2
Yield strength elasticity	≥ 110	N/mm^2
Elongation	≥ 40	%
Vickers Hardness	≥ 40	HV3
Compressive strength	Not relevant	N/mm^2
Modulus of elasticity	≥ 80000	N/mm^2
Melting point	420	°C
Thermal conductivity	110	W/(mK)
Electrical conductivity at 20°C	17	$\Omega^{-1}m^{-1}$
Density	7200	kg/m^3

Required testing standards are described in EN 988.

2.4 Placing on the market / Application rules

EN 988: 1996, Zinc and zinc alloys – Specifications for rolled flat products for building
EN 612: 2005, Eaves gutters with bead stiffened fronts and rainwater pipes with seamed joints made of metal sheet
BRL2034, KOMO K7054/03 zinc sheets
BRL2035, KOMO K7057/03 zinc gutters
BRL2044, KOMO K7063/03 zinc downpipes

2.5 Delivery status

NedZink material is delivered in thicknesses from 0.5 to 1.5 mm. The maximum width of sheets, coils and strips is 1,000 mm. The standard sheets are delivered in 1x2 m, 1x2.25 m and 1x3 m. Finished products are delivered to customer specification.

2.6 Base materials / Ancillary materials

Components of NedZink alloy

- Special-High-Grade zinc 99.995% (Z1 according to EN 1179): ≤ 99.835%
- Copper: 0.08 - 0.17%
- Titanium: 0.07 - 0.12%
- Aluminium: ≤ 0.015%

Auxiliary substances

Lubricant emulsion: 0.18 kg/t zinc
Lubricant oil: 0.63 kg/t zinc

2.7 Manufacture

Pre-alloy:
In order to improve the properties of zinc, and for energy saving reasons, a pre-alloy with titanium, copper and aluminium is prepared in an induction furnace. This pre-alloy is poured into ingots.

Melting:
In the melting furnace the Special High Grade (SHG) zinc and the ingots are mixed homogeneously. Zinc with the right composition is pumped to the casting furnace.

Casting:
Casting takes place from the casting furnace into a vertical casting installation. The zinc is cast into blocks, cooled down and stored for further processing.

Rolling and coiling:
Blocks coming from the casting installation are homogeneous pre-heated for the “hot rolling” process. This takes place in a gas-fired continuous oven.

During the hot rolling on a reversible rolling machine the blocks are processed to a pre-defined thickness. At the end of the rolling installation the zinc is coiled and stored to cool off.

On the reversible cold-rolling mill the coils are rolled to the desired final thickness. For cooling and lubrication of the process a special emulsion is used

Stretching and cutting:
Tensions in the coils are released by a stretching-and straightening process. The zinc is uniquely marked and slitted and cut to the desired width and length.

Quality control:
During the entire process extensive quality checks are conducted by the manufacturer and Lloyd’s Register. Quality management control according to ISO 9001.

2.8 Environment and health during manufacturing

The manufacturing process is carried out according to the rules as laid down in the environmental permit. NedZink’s policy follows the Total Quality Management (TQM). The directives of the Environmental Management System ISO14001 are an integral part of the Quality Management System ISO9001.

2.9 Product processing/Installation

NedZink material must be transported under dry and ventilated conditions. All contact between zinc and moisture during handling and transportation must be avoided. Mechanical deformation of zinc should be avoided in case the zinc temperature is not minimum 7°C.

2.10 Packaging

Titanium zinc coils and sheets are transported on wooden pallets. Packaging materials are polyethylene (PE foils) and paper/cardboard. All packaging materials are reusable and/or recyclable. Return in Germany is organized by Interseroh.

2.11 Condition of use

NedZink material develops a protective patina layer, which darkens the material slightly over time due to a reaction with oxygen and carbon dioxide (air and water). This layer is responsible for the high resistance of titanium zinc against corrosion.
Zinc in contact with air creates a zinc-oxide. Due to the influence of water a zinc-hydroxide is developed. In the final step a reaction with carbon dioxide creates a non-water-soluble coating of basic zinc carbonate, being the patina.

NedZink material is UV-resistant, non-flammable and resistant to radiating heat. Direct contact with chemical substances, especially those containing acids, has to be avoided. A list of substances to be avoided can be found on www.nedzink.com.
The material has a repellent effect to electro smog (electromagnetic radiation) and the effects of rain and snow may be neglected.

2.12 Environment and health during use

Environment
The due to air and water formed patina (zinc carbonate) is a natural protection layer. Due to this patina the transfer of zinc ions via rain water is

constantly reduced, because this protection layer is non-water-soluble.
Further transfer of zinc ions is mainly related to the air pollution with SO2. (Lit: R.H.J. Korenromp, J.C.Th. Hollander). Due to the reduction of SO2 concentration in the air, the zinc-concentration of precipitation in the rainwater has subsequently been reduced to one fifth of the former values during the last thirty years. As a result of all environmental regulations this amount will reduce even more in the future.

In aquatic systems only a small part of the total zinc concentration is available for organisms (bioavailable). It is related to the physical-chemical conditions of the receiving water body.

Health
When used according to their designated function, NedZink products will have no health effects. Zinc is an essential metal and does not accumulate in the body. The recommended daily intake of the mineral zinc is approximately 10 mg according to the Health Council of the Netherlands.

2.13 Reference service life
The service life depends on the correct application according to the guidelines for processing and installation. The theoretical lifetime according to available literature is > 100 years.[1,2]

[1] K. Orzessek, W. van Tilborg: “Corrosie van atmosferisch blootgesteld zink“; C&O, 1995,
[2] Zinc…A Sustainable Material; International Zinc Association (2010)

2.14 Extraordinary effects

Fire
Reaction to fire
According to EN 13501 - 1 Fire classification of construction products and building elements: Class A1 “non-combustible". (96/603/EC)

External fire performance
According to EN 13501 - 5 Fire classification of construction products and building elements: Class Broof. (2000/553/EC)

Change of state (burning drip down / drop-out)
The melting point is 420 °C.

Vaporization
Vaporization as zinc oxide (ZnO) occurs when heated above 650 °C. The produced ZnO smoke may cause zinc fever (diarrhea, dry throat, feverish) when inhaled over some period of time. The effects disappear completely in 1 to 2 days after the inhalation.

Water
None.

Mechanical destruction
None.

2.15 Re-use phase
Disassembly:
During disassembly of a building construction or renovations NedZink material should be separated from other materials. Zinc can then be easily collected for re-use and/or recycling.

Re-use/Recycling:
Scrap produced during the manufacturing process from NedZink material are 100% remelted and fed back completely into NedZink’s production process. The scrap from conversion and renovation work on building sites is collected and sold either directly to secondary smelting works or via a scrap metal dealer. The recycling rate for zinc sheets are over 90%.[3,4]
Credits for this recycling are appointed in module D. These credits are based on a recycling percentage of 90%.

[3]Zinc... A Sustainable Material; International Zinc Association (2010),
[4]Zinc Recycling, Closing the Loop; International Zinc Association (2011)

2.16 Disposal
Due to the effective recycling process, no zinc has to be disposed.
The eural code for collected zinc after disassembly is 17.04.04
The remaining residue, which is no longer valuable for the internal production process, is completely recycled by a third party. (eural 10.05.01).

2.17 Further information
Additional information, optional details, references, data sheets can be obtained at: www.nedzink.com

3. LCA: Calculation rules

3.1 Declared Unit
The declared unit is 1 kg of NedZink NATUREL, bright-rolled titanium zinc.

Declared unit

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

3.2 System boundary
Type of the EPD: Cradle-to-Gate for a specific product created at the NedZink production plant (declaration of a specific product from a manufacturer’s plant).. Modules A1, A2 and A3 contain information on raw- and secondary material extraction, transport to the manufacturer, manufacturing and packaging. The possible credits after End-of-Life of the product are also included (module D). No other modules are included in the EPD. Considering the economic value of zinc, the end-of-waste stadium is met after deconstruction of the metal from the building (using hand-tools). As such, there will be no contribution from module C.

3.3 Estimates and assumptions
No assumptions and estimations were necessary for the LCA.

3.4 Cut-off criteria
No cut-off criteria were applied to primary information. However, for some data a generic database was used. The data in this database can contain cut-offs.

Additionally, the LCI for SHG Zinc is based on the GaBi 4 database, which can contain cut-offs.

3.5 Background data

Background processes are taken from the Ecoinvent database, version 2.2 (2010). Life cycle inventory data for the production of zinc concentrate and SHG Zinc was taken from the 2009 “Report Primary Zinc Life Cycle Inventory” by the International Zinc Association. The data was adapted to the specific situation of NedZink and its SHG supplier, using the Dutch energy mix. The environmental impact of the SHG Zinc was then calculated using SimaPro V8. Site-specific data was provided by NedZink and verified against earlier studies.

3.6 Data quality

The data used for this study was both of high quality and recent (primary data directly from the manufacturer).

3.7 Period under review

Site-specific data for the year 2012 was used in this study. Background data is taken from the Ecoinvent database, version 2.2 (2010) and varies in age.

3.8 Allocation

Allocation was avoided in this study, as required in EN 15804.

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.

4. LCA: Scenarios and additional technical information

Modules A4, B1-B7 and C1-C4 are not considered in this study. The possible credits given in Module D are based on 100% recyclability of zinc products. After the collection (a collection rate of 90% was assumed), zinc scrap is re-melted and converted to secondary zinc. This is not done by NedZink but by third parties. The possible credit for the zinc gained through re-melting is calculated using the dataset of the primary zinc production.

NedZink THINK ZINK

5. LCA: Results

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	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	X

RESULTS OF THE LCA - ENVIRONMENTAL IMPACT: 1 kg of NEDZINK natural

Parameter	Unit	A1-A3	D
Global warming potential	[kg CO_2-Eq.]	1.71E+0	-1.15E+0
Depletion potential of the stratospheric ozone layer	[kg CFC11-Eq.]	9.89E-8	-7.40E-8
Acidification potential of land and water	[kg SO_2-Eq.]	1.14E-2	-9.64E-3
Eutrophication potential	[kg $(PO_4)^{3-}$-Eq.]	2.17E-3	-1.82E-3
Formation potential of tropospheric ozone photochemical oxidants	[kg ethene-Eq.]	1.23E-4	-8.09E-5
Abiotic depletion potential for non-fossil resources	[kg Sb-Eq.]	8.29E-5	-7.24E-5
Abiotic depletion potential for fossil resources	[MJ]	-	-

RESULTS OF THE LCA - RESOURCE USE: 1 kg of NEDZINK natural

Parameter	Unit	A1-A3	D
Renewable primary energy as energy carrier	[MJ]	1.27E+0	3.67E-1
Renewable primary energy resources as material utilization	[MJ]	-	-
Total use of renewable primary energy resources	[MJ]	1.27E+0	3.67E-1
Non-renewable primary energy as energy carrier	[MJ]	1.97E+1	-1.17E+1
Non-renewable primary energy as material utilization	[MJ]	-	-
Total use of non-renewable primary energy resources	[MJ]	1.97E+1	-1.17E+1
Use of secondary material	[kg]	-	-
Use of renewable secondary fuels	[MJ]	-	-
Use of non-renewable secondary fuels	[MJ]	-	-
Use of net fresh water	[m³]	5.20E-2	-

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

Parameter	Unit	A1-A3	D
Hazardous waste disposed	[kg]	-	-
Non-hazardous waste disposed	[kg]	4.87E-3	-
Radioactive waste disposed	[kg]	-	-
Components for re-use	[kg]	-	-
Materials for recycling	[kg]	-	9.00E-1
Materials for energy recovery	[kg]	-	-
Exported electrical energy	[MJ]	-	-
Exported thermal energy	[MJ]	-	-

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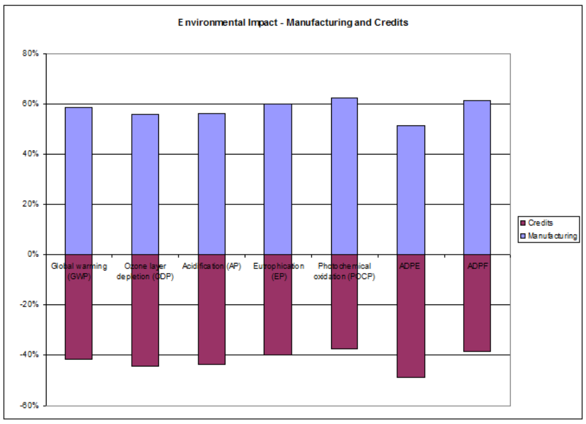
6. LCA: Interpretation



Impact categories for 1 kg of Naturel zinc

Life cycle inventory data for the production of zinc concentrate and SHG Zinc was adapted to the specific situation of NedZink and its SHG supplier, using the Dutch energy mix. (see also 3.5 Background Data)
The contribution of Special High Grade Zinc (SHG Zinc) is the dominating factor in the **GWP** (Global Warming Potential) with a 74% contribution. The remaining 26% mainly consists of energy usage (electricity and gas) with a small contribution from the remaining metal components (Cu, Ti, Al). Because of the high contribution of SHG Zinc and the high recyclability, the amount of credits gained in module D is equal to 71% of the initial impact value.
The **ODP** (Ozone Layer Depletion) is mainly determined by the SHG Zinc contribution (83%). The remainder consists mainly of energy usage during the fabrication process (melting, rolling). Credits are determined by recycled zinc.
The **AP** (Acidification Potential) is dominated by the contribution of SHG Zinc (92%). The remainder is largely influenced by energy usage.
The **EP** (Eutrophication Potential) is again mainly determined by the contribution of SHG Zinc (89%). The remainder is largely influenced by the other metal usages and energy usage across the various production stages.
The contribution of SHG Zinc to the **POCP** (Photochemical Oxidation) is 66%. The remainder is attributed mainly to energy usage.
The **ADPE** (Abiotic Depletion Potential) is almost entirely consistent of the SHG Zinc contribution (97%) with negligible contributions from other processes. As such, the amount of credits gained in module D is very close to the initial contribution.
The **ADPF** (Abiotic Depletion Potential Fossil resources) is mainly determined by SHG Zinc (66%), and energy usage across the various stages.

7. Requisite evidence

In a literature study of TNO[5] the emissions from corrosion of zinc to water has been evaluated. This corrosion rate refers to the loss of metallic zinc. The run-off rate is the wash-off of zinc from the patina layer. This run-off rate is generally lower than the corrosion rate.

During the built up of the zinc patina layer the run-off is lower than the corrosion rate. The growth of the patina layer delays the corrosion. The run-off rate is influenced by the atmospheric conditions, of which the SO_2 concentration is the most important variable. With the decreasing of the SO_2 concentration, the corrosion rate is also decreasing.

In areas with higher SO_2-concentration a run-off rate off 3 g/m2.yr can be calculated and 2 g/m2.yr in areas with lower concentration.

[5]TNO-MEP-R99/441

8. References

Institut Bauen und Umwelt
Institut Bauen und Umwelt e.V., Berlin(pub.): Generation of Environmental Product Declarations (EPDs);

General principles
for the EPD range of Institut Bauen und Umwelt e.V. (IBU), 2013/04
www.bau-umwelt.de

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

EN 15804
EN 15804:2012-04+A1 2013: Sustainability of construction works — Environmental Product Declarations — Core rules for the product category of construction products

PCR Part B
Institut Bauen und Umwelt e.V., Berlin (pub.): Product Category Rules for Construction Products from the range of Environmental Product Declarations of Institut Bauen und Umwelt (IBU), Part B: Requirements on the EPD for structural steels. July 2014
www.bau-umwelt.de

PCR Part A
Institut Bauen und Umwelt e.V., Berlin (pub.): Product Category Rules for Construction Products from the range of Environmental Product Declarations of Institut Bauen und Umwelt (IBU), Part A: Calculation Rules for the Life Cycle Assessment and Requirements on the Background Report. September 2012
www.bau-umwelt.de

ISO 9001
ISO 9001:2008
Quality management systems — Requirements

ISO 14040
NEN EN ISO 14040:2006
Environmental management - Life cycle assessment - Principles and framework

ISO 14044
NEN EN ISO 14044:2006
Environmental management - Life cycle assessment - Requirements and guidelines

KOMO product certificates
BRL2034: K7054/03 zinc sheets
BRL2035: K7057/03 zinc gutters
BRL2044: K7063/03 zinc downpipes

Product certificate Industrial Quality Scheme for Product Certification by Surveillance of Quality Systems (approval No QIS 122).
Lloyd's Register EMEA

EN 988
NEN EN 988:1996-11
Zinc and zinc alloys - Specification for rolled flat products for building

EN 1179
NEN EN 1179:2003-06
Zinc and zinc alloys - Primary zinc

EN 612
NEN EN 612:2005-02
Eaves gutters with bead stiffened fronts and rainwater pipes with seamed joints made of metal sheet

EN 13501-1
NEN EN 13501-1:2007+A1:2009
Fire classification of construction products and building elements - Part 1: Classification using data from reaction to fire tests

EN 13501-5
NEN EN 13501-5:2006+A1:2009
Fire classification of construction products and building elements - Part 5: Classification using data from external fire exposure to roofs tests

Report Primary Zinc Life Cycle Inventory
International Zinc Association (2009)

Zinc…A Sustainable Material
International Zinc Association (2010)

Zinc Recycling, Closing the Loop
International Zinc Association (2011)

R.H.J. Korenromp, J.C.Th. Hollander: "Diffusive Emissions of zinc due to atmospheric corrosion of zinc and zinc coated (galvanised) materials", TNO-MEP-99/441 (1999)

dr. P. Versloot, ir. M. de Vries: "Vastleggen recyclingsysteem voor bouwzink", Intron rapport 96078 (1996)

K. Orzessek, W. van Tilborg: "Corrosie van atmosferisch blootgesteld zink", C&O (1995)

Klimaschutz-Zertifikat 2012
Interseroh Dienstleistungs GmbH

SimaPro V8
Life Cycle Assessment software

Ecoinvent V2.2
Life Cycle Inventory database, 2010

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