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The Norwegian EPD Foundation

ENVIRONMENTAL PRODUCT DECLARATION

in accordance with ISO 14025, ISO 21930 and EN 15804

Owner of the declaration:	Hydro Aluminium AS
Program operator:	The Norwegian EPD Foundation
Publisher:	The Norwegian EPD Foundation
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Issue date:	08.09.2020
Valid to:	08.09.2025

Hydro HyForge Aluminium for forging

Hydro Aluminium AS

www.epd-norge.no

General information

Product:
Hydro HyForge Aluminium for forging

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Declaration number:
NEPD-2349-1085-EN

Place of production:
Husnes

ECO Platform reference number:

Management system:
ISO 14001, ISO 50001

This declaration is based on Product Category Rules:
CEN Standard EN 15804 serves as core PCR
NPCR 013, "Version 3.0 Part B for steel and aluminium construction products"

Organisation no:
917 537 534

Statement of liability:
The owner of the declaration shall be liable for the underlying information and evidence. EPD Norway shall not be liable with respect to manufacturerinformation, life cycle assessment data and evidences.

Issue date:
08.09.2020

Valid to:
08.09.2025

Declared unit:
1 kg of Hydro HyForge Aluminium for forging produced according to the certified Hydro Reduxa 4.0 route

Year of study:
2020

Declared unit with option:
1 kg of Hydro HyForge Aluminium for forging produced according to the certified Hydro Reduxa 4.0 route, including waste handling and possible environmental benefits after end of life.

Comparability:
EPD of construction products may not be comparable if they not comply with EN 15804 and seen in a building context.

Functional unit:
The product is an input to several products. No use scenarios are defined, hence no functional unit.

The EPD has been worked out by:
Irmeline de Sadeleer, Andreas Brekke, Kari-Anne Lyng

NORSUS
Norwegian Institute for Sustainability Research

Verification:

The CEN Norm EN 15804 serves as the core PCR. Independent verification of the declaration and data, according to ISO14025:2010

internal external

Third party verifier:

Jane Anderson

Jane Anderson, Construction LCA Limited
(Independent verifier approved by EPD Norway)

Approved

Håkon Hauan
Managing Director of EPD-Norway

Product

Product description:

This EPD covers Reduxa HyForge casthouse products made from Hydro Reduxa certified low carbon footprint aluminium. https://www.hydro.com/en-NO/products-and-services/low-carbon-aluminium/hydro-reduxa-4.0/

The primary Aluminum used in the products is produced based on renewable power production in Norway. This ensures a maximum Carbon footprint of 4.09 tons CO_2e/tAl, of which infrastructure acounts for 0,09 CO_2e/t.

Exampe of applications:

Automotive: Chassis components, powertrain components. Non automotive: high pressure tanks, scuba tanks, fire extinguisher tanks, bicycle parts, motorbike parts.

All products are produced at Husnes Primary casthouses in Norway.

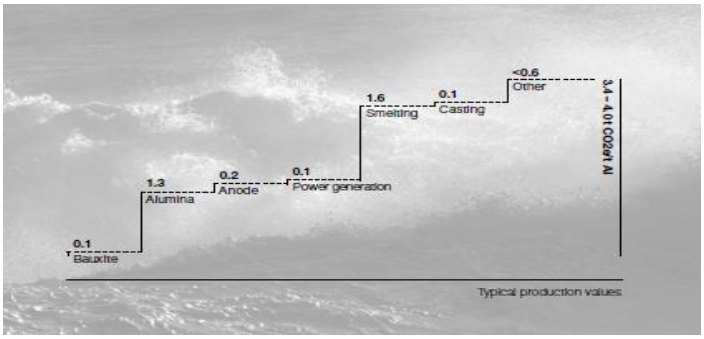
All products are produced according to EN-603, and customer specifications. The products are variants within the 6000-alloy groups.

Product specification:

Typical content of the Aluminium Products:

Materials	kg	%
Primary Liquid Al from own Electrolysis	0.956	96 %
Primary Metal from external sources	0.015	1 %
Alloying Elements	0.029	3 %

Typical values for products following the Reduxa production route



Technical data:

All products are produced with Hycast Low Pressure (LPC) casting technology. The product has a lean inverse segregation zone (ISZ). As a result, there is no need for further process steps like scalping, extrusion or machining. The HyForge™ material can thus be used directly in the forging or impact extrusion process. The material is Ultrasonic tested with EN- B594 Class A. For more detailed information about shapes, dimensions and tolerances:
https://www.hydro.com/en-NO/products-and-services/casthouse-products/hyforge/

Typical Material Properties 6082

Name	Typical values 6082	Unit
Density	2.7	kg/dm3
Modulus of elasticity	69	kN/mm2
Shear modulus	25	kN/mm2
Linear expansion coefficient 20-100 °C	23	µ°C-1
Thermal conductivity 20 °C	180	W/(m•K)
Specific heat capacity 0-100 °C	897	J/(/kg•k)
Melting range	580-650	°C
Chemical composition	97	%Al

Reference service life, product:

Depends on product application, but the material itself has an infinite life time.

Market:

Europe and Global

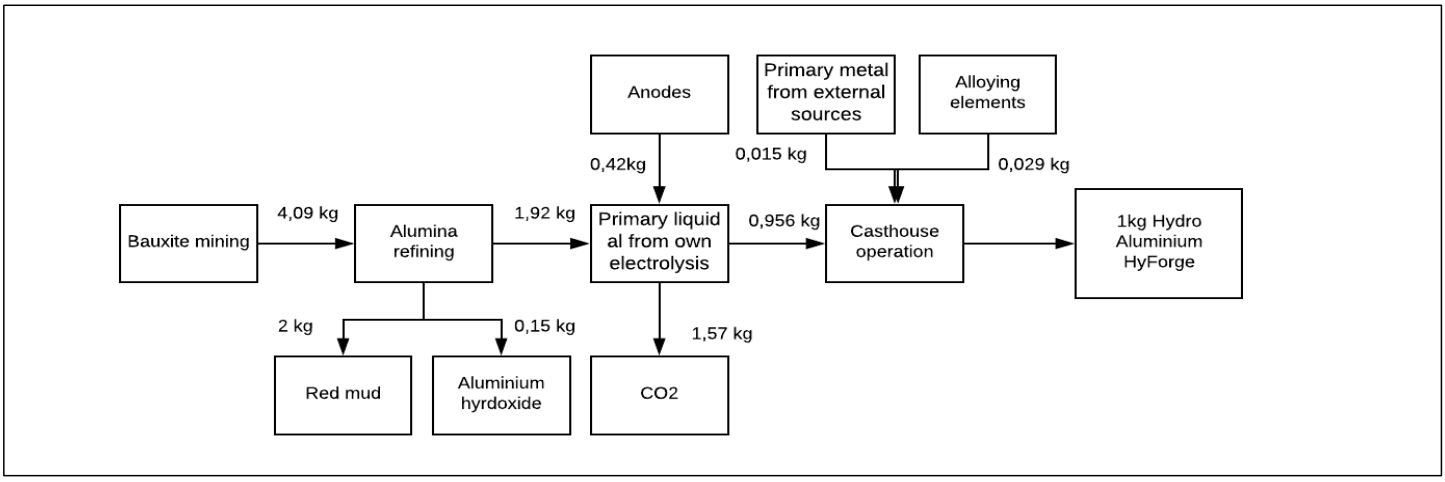
LCA: Calculation rules

Declared unit:
1 kg of Hydro HyForge Aluminium for forging produced according to certified Hydro Reduxa 4.0 route. The EPD also covers modules C2-C4 and D.
The Hydro HyForge Aluminium for forging is produced in the Husnes smelter. The results are based on the production volumes of 2017.

System boundary:
Cradle to gate with options. The following stages have been declared: A1-A4, C2-C4 and D. Further specificed in flow sheet below.

Module D covers the potential benefits from recycling of Hydro HyForge Aluminium for forging after end of useful life. Module D covers all necessary stages from C3 until the aluminium is back on to the market and compares to the environmental performance of an average market forge ingot. The module is further specified under scenarios.

Mass balance over the Hydro HyForge Aluminium for forging value chain:



Data quality:
Specific data were used for all of Hydro's processes, based on the production year 2017, and were collected the first months of 2019. As Hydro has ownership in a total value chain from mining of bauxite to production of HyForge, all stages from A1 to A4 are covered by specific data. Background data on for instance transport and electricity production are from ecoinvent 3.4 (April 2018).

Cut-off criteria:
All major raw materials and all the essential energy flows are included. The production processes for raw materials and energy flows with very small amounts (<1%) were not included in this analysis. This cut-off rule does not apply to hazardous materials and substances, but mostly to alloying elements that are added in less than per thousandth.

Allocation:
The allocation is made in accordance with the provisions of EN 15804. Incoming energy, water and waste production inhouse are allocated equally among all products through mass allocation. For almost all processes, detailed data are provided for each step, and the main allocation is done between aluminium hydroxide and aluminium oxide in the production of alumina. Effects of primary production of recycled materials are allocated to the main product in which the material was used. The recycling process and transportation of the material are allocated to this analysis.

LCA: Scenarios and additional technical information

The following information describe the scenarios in the different modules of the EPD.

The transport from the Husnes production site to market first happens by boat to a location in cental Europe. Therefrom, the average distance by truck is assumed to be 500km.

Transport from production place to user (A4)

Type	Capacity utilisation (incl. return) %	Type of vehicle	Distance km	Fuel/Energy consumption
Truck	50	Lorry, >32 metric tons, Euro V	500	2.46 E-02 l/tkm
Boat	80	Cargo ship, 5000 tons	954	1.56 E-02 l/tkm

Most of the aluminium used in the automotive industry is collected (approximately 95%) and recycled (approximately 97% of the collected aluminium), giving a total of 92% recycled. The rest is assumed landfilled.

End of Life (C2, C3, C4)

	Unit	Value
Hazardous waste disposed	kg	-
Collected	kg	0,95
Reuse	kg	-
Recycling	kg	0,923
Energy recovery	kg	0.027*
To landfill	kg	0.05**

* 27 grams of the original 1 kg of aluminium is going to incineration. No loads or beneifts are attribuded to this flow.

**There will be a small portion of aluminium ending as uncollected. This is included under "To landfill" where no loads or benefits are included.

Transport to waste processing (C2)

Type	Capacity utilisation	Type of vehicle	Distance km	Fuel/Energy
Truck	40	Lorry, >32 metric tons, Euro V	50	2.85 E-02 l/tkm

Aluminium from the shredder to waste handling site is assumed to be transported in an older medium-sized lorry with smaller capacity utilization than in the production system.

Benefits and loads beyond the system boundaries (D)

	Unit	Value
Aluminium foundry alloy to recycling	g	924

Aluminium collected and recycled is assumed to replace an average extrusion ingot in Europe consisting of 40% recycled and 60% primary aluminium. This is a conservative approach.

LCA: Results

All results are calculated with the use of SimaPro v.9 (2019) and impact methods according to ISO 15804. Results are based on a weighted average between three production sites.

System boundaries (X=included, MND= module not declared, MNR=module not relevant)

Product stage			Assemby stage		Use stage							End of life stage				Beyond the system boundaries
Raw materials	Transport	Manufacturing	Transport	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	MND	MND	MND	MND	MND	MND	MND	MND	MND	x	x	x	x

Environmental impact

Parameter	Unit	A1-A3	A4	C2	C3	C4		D	
GWP	kg CO_2-eqv	4,09E+00	5,90E-02	7,77E-03	2,48E-01	0,00E+00		-4,87E+00	
ODP	kg CFC11-eqv	3,46E-07	1,67E-08	1,44E-09	9,62E-09	0,00E+00		-2,98E-07	
POCP	kg C_2H_4-eqv	9,54E-04	1,74E-05	1,29E-06	3,03E-05	0,00E+00		-2,61E-03	
AP	kg SO_2-eqv	2,08E-02	4,20E-04	3,05E-05	6,97E-04	0,00E+00		-3,10E-02	
EP	kg PO_4^{3-}-eqv	6,91E-03	6,20E-05	7,15E-06	4,99E-04	0,00E+00		-7,67E-03	
ADPM	kg Sb-eqv	1,26E-05	8,76E-08	2,34E-08	1,64E-06	0,00E+00		-1,22E-05	
ADPE	MJ	3,35E+01	1,42E+00	1,25E-01	1,34E+00	0,00E+00		-4,71E+01	

GWP Global warming potential; ODP Depletion potential of the stratospheric ozone layer; POCP Formation potential of tropospheric photochemical oxidants; AP Acidification potential of land and water; EP Eutrophication potential; ADPM Abiotic depletion potential for non fossil resources; ADPE Abiotic depletion potential for fossil resources

Resource use

Parameter	Unit	A1-A3	A4	C2	C3	C4		D	
RPEE	MJ	5,71E+01	1,06E-02	1,19E-03	1,71E-01	0,00E+00		-2,29E+01	
RPEM	MJ	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00		0,00E+00	
TPE	MJ	5,71E+01	1,06E-02	1,19E-03	1,71E-01	0,00E+00		-2,29E+01	
NRPE	MJ	3,39E+01	1,36E+00	1,20E-01	1,52E+00	0,00E+00		-5,72E+01	
NRPM	MJ	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00		0,00E+00	
TRPE	MJ	3,39E+01	1,36E+00	1,20E-01	1,52E+00	0,00E+00		-5,72E+01	
SM	kg	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00		0,00E+00	
RSF	MJ	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00		0,00E+00	
NRSF	MJ	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00		0,00E+00	
W	m^3	6,40E-02	0,00E+00	2,25E-05	7,37E-04	0,00E+00		-4,36E-02	

RPEE Renewable primary energy resources used as energy carrier; RPEM Renewable primary energy resources used as raw materials; TPE Total use of renewable primary energy resources; NRPE Non renewable primary energy resources used as energy carrier; NRPM Non renewable primary energy resources used as materials; TRPE Total use of non renewable primary energy resources; SM Use of secondary materials; RSF Use of renewable secondary fuels; NRSF Use of non renewable secondary fuels; W Use of net fresh water

End of life - Waste									
Parameter	**Unit**	**A1-A3**	**A4**	**C2**	**C3**	**C4**		**D**	
HW	kg	4,73E-02	6,28E-07	7,60E-08	6,10E-03	0,00E+00		4,91E-03	
NHW	kg	3,39E+00	6,68E-02	6,35E-03	1,15E+00	1,00E+00		-2,49E+00	
RW	kg	1,58E-04	9,42E-06	8,11E-07	4,80E-06	0,00E+00		-2,26E-04	

HW Hazardous waste disposed; NHW Non hazardous waste disposed; RW Radioactive waste disposed

End of life - Output flow									
Parameter	**Unit**	**A1-A3**	**A4**	**C2**	**C3**	**C4**		**D**	
CR	kg	-	-	-	-	-		-	
MR	kg	-	-	-	9,24E-01	-		-	
MER	kg	-	-	-	2,57E-02	-		-	
EEE	MJ	-	-	-	-	-		-	
ETE	MJ	-	-	-	-	-		-	

CR Components for reuse; MR Materials for recycling; MER Materials for energy recovery; EEE Exported electric energy; ETE Exported thermal energy

Reading example: 9.0 E-03 = $9.0*10^{-3}$ = 0.009

Additional Norwegian requirements

Greenhouse gas emission from the use of electricity in the manufacturing phase
National production mix from import, low voltage (production of transmission lines, in addition to direct emissions and losses in grid) of applied electricity for the manufacturing prosess (A3).

Data source	Amount	Unit
econinvent v3.4 (April 2018)	4	g CO_2-eqv/kWh

Dangerous substances

x	The product contains no substances given by the REACH Candidate list or the Norwegian priority list
	The product contains substances given by the REACH Candidate list or the Norwegian priority list that are less than 0.1 % by weight.
	The product contain dangerous substances, more than 0.1% by weight, given by the REACH Candidate List or the Norwegian Priority list, see table.
	The product contains no substances given by the REACH Candidate list or the Norwegian priority list. The product is classified as hazardous waste (Avfallsforskiften, Annex III), see table.

Name	CAS no.	Amount

Indoor environment
Not relevant

Carbon footprint

Calculations connected to climate change and global warming potential (GWP) include greenhouse gas emissions from fossil sources and land use change connected to extraction of bauxite, but does not include calculations of biogenic emissions of CO_2.

Bibliography

ISO 14025:2010	*Environmental labels and declarations - Type III environmental declarations - Principles and procedures*
ISO 14044:2006	*Environmental management - Life cycle assessment - Requirements and guidelines*
EN 15804:2012+A1:2013	*Sustainability of construction works - Environmental product declaration - Core rules for the product category of construction products*
ISO 21930:2007	*Sustainability in building construction - Environmental declaration of building products*
NPCR 013	*NPCR 013 version 3.0 Part B for steel and aluminium construction products.*
Sadeleer, I., Brekke, A. and Lyng, Kari-Anne (2020)	*Background report for the Environmental Product Declarations for Hydro Aluminium Reduxa HyForge*

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