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Environmental product declaration

In accordance with ISO 14025 and EN15804+A2

Fram Aquaculture G64 Chain – Galvanized

nøsted &
TRYGG IGLAND FRAM

EPD-Global

Owner of the declaration:
Nøsted & AS

Product:
Fram Aquaculture G64 Chain – Galvanized

Declared unit:
1 kg

This declaration is based on Product Category Rules:
CEN Standard EN 15804:2012+A2:2019 serves as core PCR
NPCR 013:2021 Part B for Steel and aluminium construction products

Program operator:
EPD-Global

Declaration number:
NEPD-14528-14988

Issue date:
19.12.2025

Valid to:
19.12.2030

EPD software:
LCAno EPD generator ID: 1372130

General information

Product

Fram Aquaculture G64 Chain – Galvanized

Owner of the declaration:

Nøsted & AS
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Manufacturer:

Nøsted & AS

Declaration number:

NEPD-14528-14988

Place of production:

Nøsted & AS
Grønviksveien 8
4515 Mandal, Norway

This declaration is based on Product Category Rules:

CEN Standard EN 15804:2012+A2:2019 serves as core PCR
NPCR 013:2021 Part B for Steel and aluminium construction products

Management system:

ISO 9001/14001

Statement of liability:

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

Organisation no:

914 781 213

Declared unit:

1 kg Fram Aquaculture G64 Chain – Galvanized

Issue date:

19.12.2025

Declared unit with option:

A1-A3, A4, A5, C1, C2, C3, C4, D

Valid to:

19.12.2030

Year of study:

2024

Functional unit:

The declared unit is 1 kg finished galvanized alloy chain, ready for use in marine and aquaculture mooring applications.

Comparability:

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

General information on verification of EPD from EPD tools:

Independent verification of data, other environmental information and the declaration according to ISO 14025:2010, § 8.1.3 and § 8.1.4. Verification of each EPD is made according to EPD-Global's guidelines for verification and approval requiring that tools are i) integrated into the company's environmental management system, ii) the procedures for use of the EPD tool are approved by EPD-Global, and iii) the process is reviewed annually by an independent third party verifier. See Appendix G of EPD-Global's General Programme Instructions for further information on EPD tools

Development and verification of EPD:

The declaration is created using EPD tool lca.tools ver EPD2022.03, developed by LCA.no. The EPD tool is integrated in the company's management system, and has been approved by EPD-Global. Approval number: NEPDT183 Nøsted & AS

Developer of EPD: Arne Edvard Taanevig

Reviewer of company-specific input data and EPD: Andrius Kondrasovas

Verification of EPD tool:

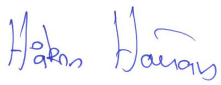
Independent third party verification of the EPD tool, background data and test-EPD in accordance with EPD-Global's procedures and guidelines for verification and approval of EPD tools.

Third party verifier:

Alexander Borg, Asplan Viak AS

(no signature required)

Approved:



Håkon Hauan, CEO EPD-Global

Product

Product description:

The product is an alloy steel chain intended for demanding marine, aquaculture and general mooring applications. The chain is manufactured at Nøsted & AS in Mandal, Norway, using high-quality West European steel, heat-treated for increased toughness and proof-load tested link by link.

The chain is available in two corrosion-protection variants:

• Fram Aqua (thermo-galvanized):
A thermochemical zinc diffusion process that forms a smooth, hard and highly durable corrosion-resistant layer with excellent fatigue performance. Fram Aqua chains are certified in accordance with NS 9415 for use in floating aquaculture installations.

• Hot-dip galvanized (HDG):
A traditional zinc coating applied by immersion in molten zinc, in accordance with NS 9419. Used for fishery, trawl operations and general industrial applications.

The product family covers short-link, mid-link and long-link chain geometries, all produced according to the same manufacturing and heat-treatment principles. The chains are fully compatible with FRAM Aqua mooring components such as shackles, master links and mooring plates.

Product specification

Corrosion protection is applied after controlled heat treatment. For Fram Aqua thermo-galvanized chains, zinc is diffused into the steel surface through a thermochemical process without acidic pickling, eliminating the risk of hydrogen embrittlement. HDG chains are coated by immersion in molten zinc in accordance with NS 9419.

The product family includes short-link, mid-link and long-link chain geometries, all produced using the same alloy steel, heat-treatment process and mechanical testing requirements.

All chain links undergo 100% proof-load testing. Additional mechanical and metallurgical testing is performed to ensure strength, toughness and long-term corrosion resistance in marine environments.

Materials	kg	%
Metal - Steel	1.00	100.00
Total	1.00	100.00

Packaging	kg	%
Packaging - Wood	0.00125	100.00
Total incl. packaging	1.00	100.00

Technical data:

Base material: Alloy steel (West European origin)
Manufacturing site: Nøsted & AS, Mandal, Norway
Heat treatment: Through hardening + tempering for increased toughness
Surface protection options:
- Thermo-galvanized (Fram Aqua), NS 9415 compliant
- Hot-dip galvanized (HDG), NS 9419 compliant

Chain geometries included: Short-link, mid-link and long-link configurations
Testing: 100% proof-load testing of each individual chain link
Traceability: Full batch traceability to steel melt and production lot

Market:

The products are supplied globally, with primary markets in Europe and North America. Typical application areas include aquaculture mooring systems, marine operations, trawl gear and general industrial use where high load capacity and corrosion resistance are required

Reference service life, product

The service life depends on application, load conditions, water salinity, inspection intervals and corrosion exposure. Regular inspection, documentation of wear, and replacement of damaged components help extend the operational lifetime. Chains used in aquaculture systems follow the inspection and replacement intervals defined in NS 9415.

Reference service life, building or construction works

NA

LCA: Calculation rules

Declared unit:

1 kg Fram Aquaculture G64 Chain – Galvanized

Cut-off criteria:

All major raw materials and all the essential energy is included. The production processes for raw materials and energy flows with very small amounts (less than 1%) are not included. These cut-off criteria do not apply for hazardous materials and substances.

Allocation:

The allocation is made in accordance with the provisions of EN 15804. Incoming energy and water and waste production in-house is allocated equally among all products through mass allocation. Effects of primary production of recycled materials is allocated to the main product in which the material was used. The recycling process and transportation of the material is allocated to this analysis.

Data quality:

Specific data for the product composition are provided by the manufacturer. The data represent the production of the declared product and were collected for EPD development in the year of study. Background data is based on EPDs according to EN 15804 and different LCA databases. The data quality of the raw materials in A1 is presented in the table below.
Primary manufacturing data is sourced directly from the Nøsted & AS Mandal plant. Secondary data for raw materials, energy, and transport is sourced from recognized LCI databases in accordance with EN 15804+A2. Data quality is considered high.

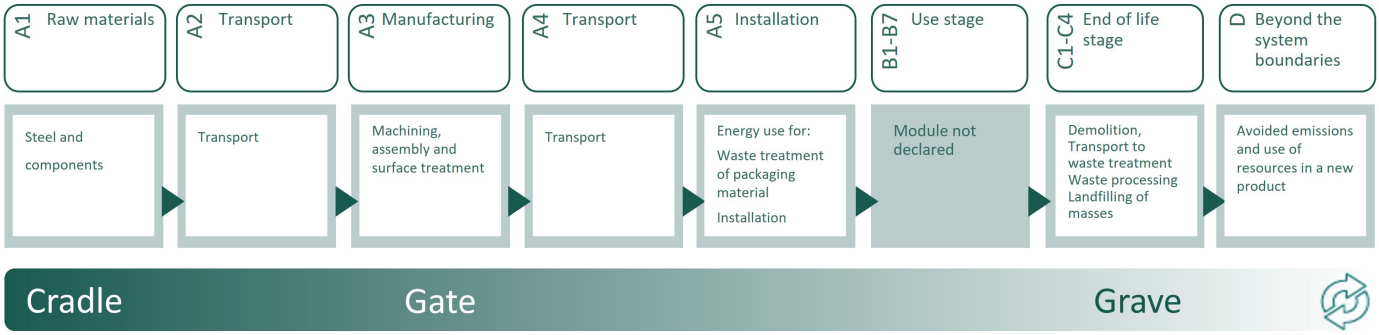
Materials	Source	Data quality	Year
Metal - Steel	S-P-06129	EPD	2023
Packaging - Wood	Modified ecoinvent 3.6	Database	2019

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

Product stage			Construction installation 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	X	MND	MND	MND	MND	MND	MND	MND	X	X	X	X	X

System boundary:

This EPD covers modules A1–A5 and C1–C4, with module D included. The use phase (B1–B7) is not included due to lack of relevant emissions or impacts during normal operation. Manufacturing data reflects production at Nøsted & AS in Mandal, Norway, including heat treatment, galvanization, testing and packaging.



Additional technical information:

This EPD includes galvanized alloy chain G64 for marine, trawl and aquaculture mooring systems. Both thermo-galvanized (Fram Aqua) and standard hot-dip galvanized (HDG) coating variants are included. The environmental impact difference between the coating methods is small relative to the total product footprint.

LCA: Scenarios and additional technical information

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

A4: General freight not included due to this EPD being designed as a base EPD
A5: Not included due to lack of relevant energy use in installation of products
C1: Not included due to lack of relevant energy use in demolition of products

Transport from production place to user (A4)	Capacity utilisation (incl. return) %	Distance (km)	Fuel/Energy Consumption	Unit	Value (Liter/tonne)
Truck, 16-32 tonnes, EURO 6 (km) - Europe	36.7 %	300.00	0.043	l/tkm	12.90

Assembly (A5)	Unit	Value			
Waste, packaging, pallet, EUR wooden pallet, reusable, average treatment (kg)	kg	0.00125			

Transport to waste processing (C2)	Capacity utilisation (incl. return) %	Distance (km)	Fuel/Energy Consumption	Unit	Value (Liter/tonne)
Truck, 16-32 tonnes, EURO 5 (km) - Europe	36.7 %	85.00	0.044	l/tkm	3.74

Waste processing (C3)	Unit	Value			
Waste, Materials to recycling (kg)	kg	0.90			

Disposal (C4)	Unit	Value			
Waste, scrap steel, to landfill (kg)	kg	0.10			

Benefits and loads beyond the system boundaries (D)	Unit	Value			
Substitution of primary steel with net scrap (kg)	kg	0.899			
Substitution of electricity (MJ)	MJ	0.00004312			
Substitution of thermal energy, district heating (MJ)	MJ	0.0006524			

LCA: Results

The LCA results are presented below for the declared unit defined on page 2 of the EPD document.

Environmental impact										
	Indicator	**Unit**	A1-A3	A4	A5	C1	C2	C3	C4	D
	GWP-total	kg CO_2 -eq	6.95E-01	4.90E-02	1.90E-03	0	1.42E-02	0.00E+00	4.29E-04	-9.90E-01
	GWP-fossil	kg CO_2 -eq	6.92E-01	4.90E-02	1.68E-06	0	1.42E-02	0.00E+00	4.28E-04	-9.89E-01
	GWP-biogenic	kg CO_2 -eq	8.56E-04	2.03E-05	1.89E-03	0	5.78E-06	0.00E+00	3.64E-07	-5.46E-04
	GWP-luluc	kg CO_2 -eq	1.69E-03	1.74E-05	4.31E-10	0	4.95E-06	0.00E+00	8.40E-08	-4.43E-04
	ODP	kg CFC11 -eq	2.92E-08	1.11E-08	0.00E+00	0	3.23E-09	0.00E+00	2.09E-10	-3.07E-07
	AP	mol H+ -eq	3.58E-03	1.41E-04	1.35E-08	0	5.79E-05	0.00E+00	4.18E-06	-4.92E-03
	EP-FreshWater	kg P -eq	3.70E-05	3.92E-07	2.00E-11	0	1.11E-07	0.00E+00	3.20E-09	-6.09E-05
	EP-Marine	kg N -eq	8.49E-04	2.79E-05	5.80E-09	0	1.72E-05	0.00E+00	1.57E-06	-1.02E-03
	EP-Terrestial	mol N -eq	8.59E-03	3.12E-04	6.22E-08	0	1.90E-04	0.00E+00	1.73E-05	-1.04E-02
	POCP	kg NMVOC -eq	2.89E-03	1.19E-04	1.60E-08	0	5.82E-05	0.00E+00	4.94E-06	-4.96E-03
	ADP-minerals&metals[1]	kg Sb-eq	6.97E-06	1.35E-06	2.70E-11	0	3.84E-07	0.00E+00	3.79E-09	-1.71E-05
	ADP-fossil[1]	MJ	1.44E+00	7.41E-01	1.98E-05	0	2.14E-01	0.00E+00	1.38E-02	-8.33E+00
	WDP[1]	m^3	2.50E+00	7.17E-01	3.04E-05	0	2.04E-01	0.00E+00	2.91E-02	5.13E+01

GWP-total = Global Warming Potential total; GWP-fossil = Global Warming Potential fossil fuels; GWP-biogenic = Global Warming Potential biogenic; GWP-luluc = Global Warming Potential land use and land use change; ODP = Depletion potential of the stratospheric ozone layer; AP = Acidification potential, Accumulated Exceedance; EP-freshwater = Eutrophication potential, fraction of nutrients reaching freshwater end compartment: EP-marine = Eutrophication potential, fraction of nutrients reaching marine end compartment; EP-terrestrial = Eutrophication potential, Accumulated Exceedance; POCP = Formation potential of tropospheric ozone; ADP-minerals&metals = Abiotic depletion potential for non-fossil resources; ADP-fossil = Abiotic depletion for fossil resources potential; WDP = Water (user) deprivation potential, deprivation-weighted water consumption

"Reading example: 9.0 E-03 = 9.0*10-3 = 0.009"

1. The results of this environmental impact indicator shall be used with care as the uncertainties on these results are high or as there is limited experienced with the indicator

Remarks to environmental impacts

Environmental impacts are primarily influenced by steel production and energy use during heat treatment. The difference in environmental impact between thermo-galvanization and hot-dip galvanization is small relative to the total product footprint, and both variants follow the same life cycle model in this declaration.

Additional environmental impact indicators										
Indicator		**Unit**	A1-A3	A4	A5	C1	C2	C3	C4	D
	PM	Disease incidence	5.17E-09	3.00E-09	0.00E+00	0	1.02E-09	0.00E+00	8.90E-11	-8.21E-08
	IRP[2]	kgBq U235 -eq	9.62E-03	3.24E-03	7.16E-08	0	9.34E-04	0.00E+00	6.00E-05	3.55E-03
	ETP-fw[1]	CTUe	2.80E+00	5.49E-01	2.25E-05	0	1.57E-01	0.00E+00	6.83E-03	-5.51E+01
	HTP-c[1]	CTUh	9.40E-11	0.00E+00	0.00E+00	0	0.00E+00	0.00E+00	0.00E+00	-4.76E-09
	HTP-nc[1]	CTUh	2.72E-09	6.00E-10	0.00E+00	0	1.70E-10	0.00E+00	4.00E-12	1.03E-07
	SQP[1]	dimensionless	3.83E-01	5.18E-01	1.11E-05	0	1.47E-01	0.00E+00	5.04E-02	-6.23E-01

PM = Particulate Matter emissions; IRP = Ionizing radiation – human health; ETP-fw = Eco toxicity – freshwater; HTP-c = Human toxicity – cancer effects; HTP-nc = Human toxicity – non cancer effects; SQP = Potential Soil Quality Index (dimensionless)

"Reading example: 9.0 E-03 = 9.0*10-3 = 0.009"

1. The results of this environmental impact indicator shall be used with care as the uncertainties on these results are high or as there is limited experienced with the indicator
2. This impact category deals mainly with the eventual impact of low dose ionizing radiation on human health of the nuclear fuel cycle. It does not consider effects due to possible nuclear accidents, occupational exposure nor due to radioactive waste disposal in underground facilities. Potential ionizing radiation from the soil, from radon and from some construction materials is also not measured by this indicator.

Resource use										
Indicator		**Unit**	A1-A3	A4	A5	C1	C2	C3	C4	D
	PERE	MJ	5.74E+00	1.06E-02	4.06E-07	0	3.01E-03	0.00E+00	2.13E-04	-6.76E-01
	PERM	MJ	1.74E-02	0.00E+00	-1.74E-02	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	PERT	MJ	5.76E+00	1.06E-02	-1.74E-02	0	3.01E-03	0.00E+00	2.13E-04	-6.76E-01
	PENRE	MJ	1.43E+00	7.41E-01	1.98E-05	0	2.14E-01	0.00E+00	1.38E-02	-8.32E+00
	PENRM	MJ	0.00E+00	0.00E+00	0.00E+00	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	PENRT	MJ	1.43E+00	7.41E-01	1.98E-05	0	2.14E-01	0.00E+00	1.38E-02	-8.32E+00
	SM	kg	1.06E-03	0.00E+00	0.00E+00	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	RSF	MJ	3.95E-03	3.79E-04	1.18E-08	0	1.08E-04	0.00E+00	4.39E-06	3.57E-02
	NRSF	MJ	9.05E-03	1.36E-03	1.35E-07	0	3.85E-04	0.00E+00	1.26E-05	1.04E+00
	FW	m^3	3.58E-02	7.92E-05	1.44E-08	0	2.25E-05	0.00E+00	1.65E-05	-2.08E-03

PERE = Use of renewable primary energy excluding renewable primary energy resources used as raw materials; PERM = Use of renewable primary energy resources used as raw materials; PERT = Total use of renewable primary energy resources; PENRE = Use of non renewable primary energy excluding non-renewable primary energy resources used as raw materials; PENRM = Use of non renewable primary energy resources used as raw materials; PENRT = 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; FW = Net use of fresh water

"Reading example: 9.0 E-03 = 9.0*10-3 = 0.009"

End of life - Waste

Indicator		Unit	A1-A3	A4	A5	C1	C2	C3	C4	D
	HWD	kg	3.13E-03	3.82E-05	0.00E+00	0	1.09E-05	0.00E+00	0.00E+00	-5.14E-03
	NHWD	kg	2.34E-01	3.60E-02	6.25E-05	0	1.02E-02	0.00E+00	1.00E-01	-4.04E-01
	RWD	kg	6.10E-05	5.05E-06	0.00E+00	0	1.46E-06	0.00E+00	0.00E+00	2.73E-06

HWD = Hazardous waste disposed; NHWD = Non-hazardous waste disposed; RWD = Radioactive waste disposed

"Reading example: 9.0 E-03 = 9.0*10-3 = 0.009"

End of life - Output flow

Indicator		Unit	A1-A3	A4	A5	C1	C2	C3	C4	D
	CRU	kg	0.00E+00	0.00E+00	1.19E-03	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	MFR	kg	9.19E-02	0.00E+00	1.47E-09	0	0.00E+00	9.00E-01	0.00E+00	0.00E+00
	MER	kg	1.15E-02	0.00E+00	6.20E-05	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	EEE	MJ	7.00E-03	0.00E+00	4.31E-05	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	EET	MJ	1.06E-01	0.00E+00	6.52E-04	0	0.00E+00	0.00E+00	0.00E+00	0.00E+00

CRU = Components for re-use; MFR = Materials for recycling; MER = Materials for energy recovery; EEE = Exported energy electrical; EET = Exported energy thermal

"Reading example: 9.0 E-03 = 9.0*10-3 = 0.009"

Biogenic Carbon Content

Indicator	Unit	At the factory gate
Biogenic carbon content in product	kg C	0.00E+00
Biogenic carbon content in accompanying packaging	kg C	5.17E-04

Note: 1 kg biogenic carbon is equivalent to 44/12 kg CO2

Additional requirements

Greenhouse gas emissions 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 process (A3).

Electricity mix	Source	Amount	Unit
Electricity, Norway (kWh)	ecoinvent 3.6	24.33	g CO2-eq/kWh
Electricity, Solar, Norway (kWh)	ecoinvent 3.6	104.80	g CO2-eq/kWh

Dangerous substances

The product contains no substances given by the REACH Candidate list.

Indoor environment

No emissions affecting indoor air quality are expected during use. The product is intended for outdoor marine applications.

Additional Environmental Information

Additional environmental impact indicators required in NPCR Part A for construction products									
Indicator	**Unit**	A1-A3	A4	A5	C1	C2	C3	C4	D
GWPIOBC	kg CO_2 -eq	6.95E-01	4.90E-02	1.68E-06	0	1.42E-02	0.00E+00	4.29E-04	-9.90E-01

GWP-IOBC: Global warming potential calculated according to the principle of instantaneous oxidation. In order to increase the transparency of biogenic carbon contribution to climate impact, the indicator GWP-IOBC is required as it declares climate impacts calculated according to the principle of instantaneous oxidation. GWP-IOBC is also referred to as GWP-GHG in context to Swedish public procurement legislation.

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NPCR 013 Part B for Steel and Aluminium Construction Products , Ver. 4.0, 06.10.2021, EPD Norway.

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