ENVIRONMENTAL PRODUCT DECLARATION

EPD®
THE INTERNATIONAL EPD® SYSTEM

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The Norwegian EPD Foundation

According to ISO 14025 and EN 15804

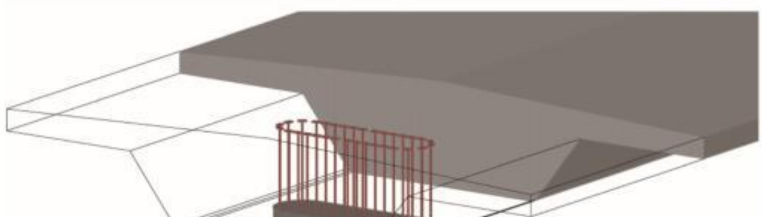
Registered under the scope of mutual recognition between
The International EPD® System and The Norwegian EPD Foundation

ECO PLATFORM EPD EN 15804 VERIFIED

Program operator: The Norwegian EPD Foundation
Publisher: International EPD® System
Declaration number: NEPD-1612-640-EN
ECO Platform registration number: 00000746
Registration number: S-P-01373
Issue date: 2018-08-13
Valid to: 2023-08-13

HRC 100, 200, 400 and 700 Series: Headed reinforcement, Rebar with mechanical couplers, cast-in connections

HRC Europe AS



General information

Product:
HRC 100, 200, 400 and 700 Series: Headed reinforcement, Rebar with mechanical couplers, Cast-in connections.

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Declaration number:
NEPD-1612-640-EN

Place of production:
Lierstranda, Norway

ECO Platform reference number:
00000746

Management system:
ISO 9001, ISO 14001

This declaration is based on Product Category Rules:
NPCR 013rev1 Steel as construction material

Organisation no:
922 875 243

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:
13.08.2018

Valid to:
13.08.2023

Declared unit:
Per kg steel product delivered at factory gate

Year of study:
2018

Declared unit with option:
Per kg steel product delivered at building site and waste treated at end of life

Comparability:
EPDs of construction products may not be comparable if they do not comply with EN 15804 or if they are not seen in a building context.

Functional unit:
Not relevant for cradle-to-gate study with option

The EPD has been worked out by:
Fredrik Moltu Johnsen, Østfoldforskning AS

Østfoldforskning

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:

sign

Jane Anderson, ConstructionLCA Ltd, UK
(Independent verifier approved by EPD Norway)

Approved

Håkon Hauan
Managing Director of EPD-Norway

Product

Product description:
Reinforcing steel bars with a component attached to one or both ends. End components are made of steel and connected to the rebar by a thermo-mechanical process, in the solid phase - without any additives. Various HRC components can be combined. The finished product is cut and bend according to project specification. This EPD covers:

- HRC 100 Series, HRC 200 Series: Headed reinforcement bars, providing mechanical anchorage and replacing anchorage lengths, bends and hooks
- HRC 400 Series: Rebar with couplers for mechanical splicing of reinforcement bars
- HRC 700 Series: Rebar with a threaded component for connection of steel components to a concrete structure

Product specification:
HRC end-components are made of steel and constitute 1-26% of the entire product weight, depending on rebar diameter and product length. The chemical content of the finished product is almost identical to that of the parent reinforcing steel. The average composition of a HRC product is:

Materials	kg	%
Rebar steel	0.897	89.7
End component steel	0.099	9.9
Stainless end component steel	0.004	0.4

Technical data:
All products are certified according to national provisions and international standards:

- HRC 100: ISO 15698, ETA-08/0035
- HRC 200: ISO 15698
- HRC 400: ISO 15835
- HRC 700: SINTEF TG 20072

Evidence for certifications can be found at the following websites:
https://www.hrc-europe.com/certifications/certifications-norway/
http://www.kontrollbetong.no/sertifiserte-foretak/?bedrift=HRC&area=0&produkter=0&submit=S%C3%98K
https://www.sintefcertification.no/no/product/index/2198/tg_20072

For further information, see HRC's website
www.hrc-europe.com

Market:
Europe

Reference service life, product:
Not relevant

Reference service life, building:
Not relevant

Recycled content of steel:
> 99% by weight

Examples of HRC-products: HRC 100 Series T-headed bars, HRC 400 Series rebar coupler and HRC 710 threaded bolt

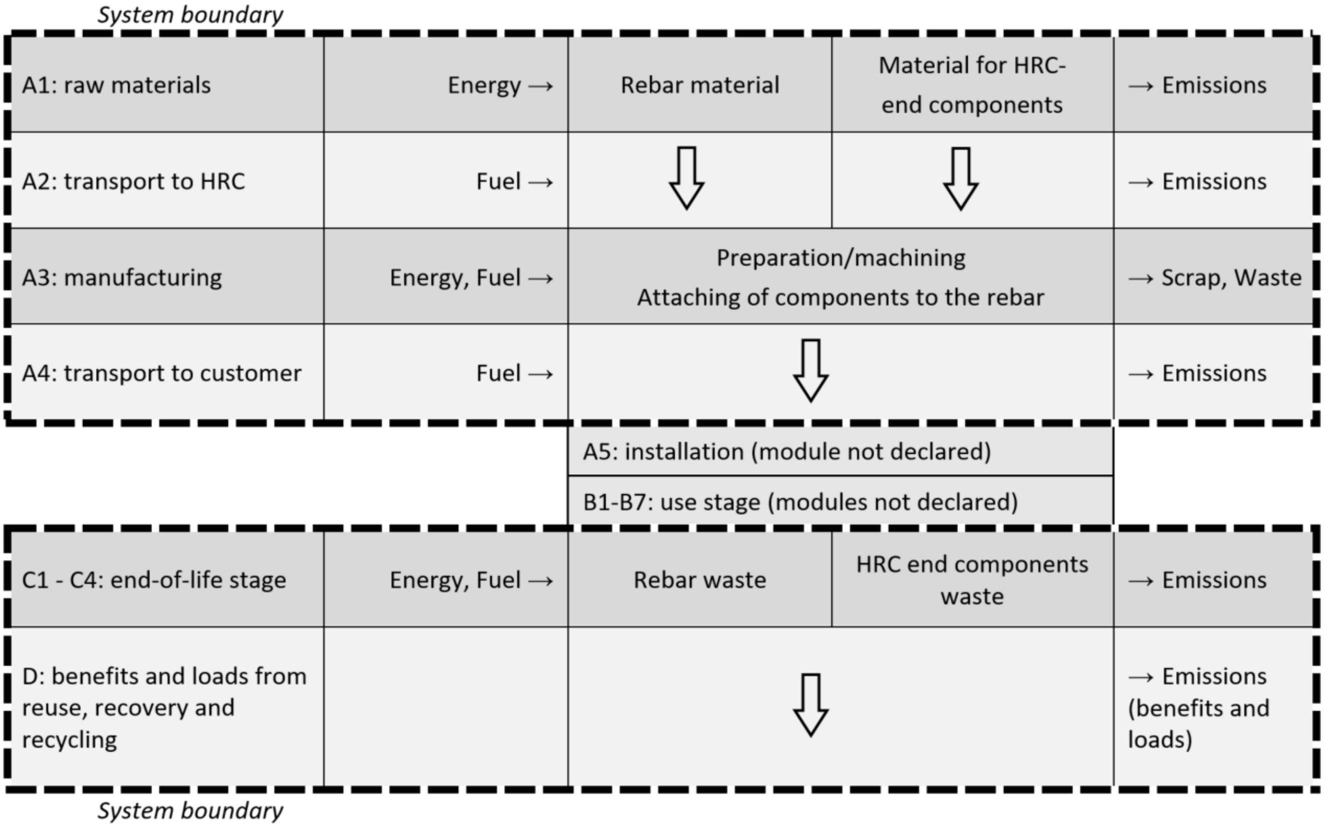
Description of HRC's production process (A3)
- The rebar is cut to length according to the production order. Small, unusable cut-off lengths are collected and sent to recycling.
- The raw material for end-components is cut to correct length/geometry. The cutting is done by band saw.
- Threaded components (rebar couplers and cast-in connections) are processed by CNC-machines. Small, unusable cut-off lengths and swarf from cutting and CNC-machining are collected and sent to recycling.
- The end components are attached to the rebar by friction welding. Friction welding is a thermos-mechanical process, much like forging. The materials being welded remain in the solid phase, no liquation or melting occurs during the process. The process uses no additional material or consumables.
- If required by the production order, products are bent by a rebar bending machine.

LCA: Calculation rules

Declared unit:
Per kg steel product delivered at factory gate

Functional unit:
Not relevant for cradle-to-gate study with option

Figure 1. System diagram of the life cycle assessment study



System boundary:
System boundaries are outlined in figure 1. See also the tabular diagram under the heading "LCA results" below. A5 (installation) and B1-B7 (use phase) are not declared. Apart from these modules, the LCA is a cradle-to-grave analysis. Module D states benefits or loads from recycling, here a negative figure means a positive environmental impact. See "Scenarios" below for further description of module D.

Data quality:
Data sources: For A3, HRC has provided data for 2015-17, and the average has been employed. The model for steel production has partly been based on previously published EPDs, partly on assumptions, and partly on generic data for applicable steel production. As for generic data, the database used has primarily been Ecoinvent v.3.4 Cut-off. Uncertainty is not declared, and should be assumed to be substantial due to the general use of approximations in LCA studies.

Allocation:
The allocation is made in accordance with the provisions of EN 15804. Incoming energy and water and waste production in-house are allocated equally among all products through mass allocation. Effects of primary production of recycled materials are allocated to the main product in which the material was used. Sorting of scrap is included in C1-C4, whereas smelting of scrap is included in A1 and not double-counted in C1-C4. Waste treatment of steel waste from A3 is included in A3.

Cut-off criteria:
All major raw materials and all the essential energy is included. The production process for raw materials and energy flows that are included with very small amounts (<1%) are in some cases not included. This cut-off rule does not apply for hazardous materials and substances, or where these flows contribute significantly more than 1% to the scores of environmental impact categories such as the GWP indicator.

Variations in results - stainless steel and HRC 720SS:
The LCA results reflect the average reinforcement product at HRC. The GWP of the stainless steel, which constitutes part of the HRC 720SS product, is approx. 12 times higher than the average results shown. This should be taken into account in the interpretation, particularly when the proportion of stainless steel in a delivery diverges substantially from HRC's average of 0.4% acid-resistant steel by mass. *The EPD is not valid for deliveries that consist of more than 1% stainless steel, as this gives a too high deviation from the EPD results.*

LCA: Scenarios and additional technical information

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

In the A4 scenario, a transport distance of **500 km** from HRC Europe, Lierstranda, to the building site has been assumed. Emissions in A4 will increase proportionally with the distance, so if the actual A4 distance is known to be e.g. 50 km, it implies that A4 emissions will make up 10% of the results in this EPD.

Transport from production place to user (A4)

Type	Capacity utilisation (incl. return) %	Type of vehicle	Distance km	Fuel/Energy consumption
Truck	44	EURO5, >32 t	500	0.023 l/tkm

The A4 table above describes the modelling assumptions made in the selected Ecoinvent database process.

End of Life (C1, C3, C4)

	Unit	Value
Hazardous waste disposed	kg	0
Collected as mixed construction waste	kg	0
Reuse	kg	0
Recycling	kg	0.98
Energy recovery	kg	0
To landfill	kg	0.02

It was assumed that 100% of the reinforced concrete is demolished, that 98% of the reinforcing steel is collected and recycled, and that 2% of the steel is lost, i.e. remains at the demolition site.

Transport to waste processing (C2)

Type	Capacity utilisation (incl. return) %	Type of vehicle	Distance km	Fuel/Energy consumption
Truck	44	EURO5, >32 t	20	0.023 l/tkm

A distance of 20 km to the nearest relevant scrap yard was assumed to be typical.

Benefits and loads beyond the system boundaries (D)

	Unit	Value
Input flow of scrap steel (A1)	kg	1.054
Output flow of scrap steel (A3 and C3)	kg	1.0575
Net output flow to module D	kg	0.0035
Benefit: Pig iron (global) (Module D)	kg	0.0035

In the module D scenario, it has been assumed that the disposed reinforcement steel scrap from C3 substitutes pig iron, on the global market. The amount of secondary steel into A1 is a load subtracted from the benefit. In practice, a scenario of substitution in the Scandinavian market would probably be more likely, and would probably give a significantly lower benefit. However, due to data availability issues in Ecoinvent, the global scenario had to be chosen. Scrap from A3 is not included in D.

LCA: Results

This section describes the system boundaries and modules of the life cycle assessment, as well as the calculated environmental impact, based on a standardized set of indicators. The indicator abbreviations are explained below each table.

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

Product stage			Assembly 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	X	X	X	X	X

Environmental impact

Parameter	Unit	A1	A2	A3	A1- A3	A4	C1	C2	C3	C4	D
GWP	kg CO_2-eqv	4,49E-01	7,67E-02	1,48E-02	5,41E-01	4,33E-02	5,78E-02	1,70E-03	3,16E-03	0	-6,24E-03
ODP	kg CFC11-eqv	6,40E-09	1,16E-08	1,84E-09	1,98E-08	8,52E-09	1,04E-08	3,34E-10	1,41E-10	0	-3,01E-10
POCP	kg C_2H_4-eqv	9,66E-05	1,25E-05	3,15E-06	1,12E-04	6,89E-06	1,16E-05	2,70E-07	5,88E-07	0	-4,54E-06
AP	kg SO_2-eqv	1,04E-03	5,24E-04	8,36E-05	1,65E-03	1,40E-04	4,37E-04	5,47E-06	1,44E-05	0	-2,59E-05
EP	kg PO_4^{3-}-eqv	2,06E-04	1,11E-04	1,89E-05	3,36E-04	2,35E-05	9,41E-05	9,21E-07	1,60E-06	0	-2,62E-06
ADPM	kg Sb-eqv	8,23E-07	5,84E-08	1,51E-07	1,03E-06	8,44E-08	1,94E-08	3,31E-09	2,40E-09	0	-1,56E-09
ADPE	MJ	2,65E+00	9,90E-01	1,72E-01	3,81E+00	6,79E-01	8,33E-01	2,66E-02	3,24E-02	0	-6,17E-02

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	A2	A3	A1- A3	A4	C1	C2	C3	C4	D
RPEE	MJ	3,93E+00	2,09E-02	1,20E+00	5,15E+00	1,20E-02	4,78E-03	4,71E-04	4,12E-03	0	-1,11E-03
RPEM	MJ	3,27E-03	0	0	3,27E-03	0	0	0	0	0	0
TPE	MJ	3,94E+00	2,09E-02	1,20E+00	5,15E+00	1,20E-02	4,78E-03	4,71E-04	4,12E-03	0	-1,11E-03
NRPE	MJ	2,73E+00	1,02E+00	2,40E-01	3,99E+00	7,00E-01	8,40E-01	2,74E-02	3,89E-02	0	-6,26E-02
NRPM	MJ	7,06E-02	0	0	0,070624	0	0	0	0	0	0
TRPE	MJ	2,80E+00	1,02E+00	2,40E-01	4,06E+00	7,00E-01	8,40E-01	2,74E-02	3,89E-02	0	-6,26E-02
SM	kg	1,19E+00	0	0	1,2E+00	0	0	0	0	0	0
RSF	MJ	2,85E-04	0	0	2,8E-04	0	0	0	0	0	0
NRSF	MJ	1,08E+00	0	0	1,1E+00	0	0	0	0	0	0
W	m^3	4,27E-02	2,91E-04	8,92E-03	5,19E-02	1,60E-04	1,28E-04	6,29E-06	1,91E-05	0	-1,07E-05

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	A2	A3	A1- A3	A4	C1	C2	C3	C4	D
HW	kg	1,83E-04	7,92E-07	2,43E-07	1,84E-04	3,55E-07	3,75E-07	1,39E-08	5,82E-08	0	-6,27E-07
NHW	kg	3,17E-01	1,99E-02	1,28E-02	3,49E-01	6,37E-02	2,40E-02	2,50E-03	2,16E-03	2,00E-02	-5,53E-03
RW	kg	INA	INA	INA	INA	INA	INA	INA	INA	INA	INA

HW Hazardous waste disposed; NHW Non hazardous waste disposed; RW Radioactive waste disposed; INA Indicator not assessed

End of life - Output flow

Parameter	Unit	A1	A2	A3	A1- A3	A4	C1	C2	C3	C4	D
CR	kg	0	0	0	0	0	0	0	0	0	0
MR	kg	0	0	8,35E-02	8,35E-02	0	0	0	0,98	0	0
MER	kg	0	0	0	0	0	0	0	0	0	0
EEE	MJ	0	0	0	0	0	0	0	0	0	0
ETE	MJ	0	0	0	0	0	0	0	0	0	0

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

Reading example: 9,0E-03 = $9{,}0 \cdot 10^{-3}$ = 0,009

The number of decimals does not indicate the uncertainty of the results.

Additional Norwegian requirements

Greenhouse gas emissions from the use of electricity in the manufacturing phase

National production mix including import, low voltage (production of transmission lines, in addition to direct emissions and losses in grid) of applied electricity for the manufacturing prosess of HRC Europe (A3).

Data source	Amount	Unit
Ecoinvent v3.4 (October 2017)	0.0313	kg CO_2-eq/kWh

Dangerous substances

- ☑ 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 then 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

No tests have been carried out on the product concerning indoor climate - Not relevant

Carbon footprint

Carbon footprint has not been worked out for the product.

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*
LCI/LCA report	Johnsen and Tellnes (2018) *HRC rebar products: Headed reinforcement, Rebar with mechanical couplers, Cast-in connections.* Østfoldforskning, Fredrikstad
PCR	*NPCR 013rev1 - Steel as construction material. Issue date: 22.08.2013*

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