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ECO PLATFORM EPD EN 15804 VERIFIED

Owner:	NLMK DanSteel A/S
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Issued:	01-10-2018
Valid to:	01-10-2023

3rd PARTY **VERIFIED**

EPD

VERIFIED ENVIRONMENTAL PRODUCT DECLARATION | **ISO 14025 & EN 15804**

Owner of declaration
NLMK DanSteel A/S
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DK-3300 Frederiksvaerk
VAT: 10092922

Programme operator
Danish Technological Institute
www.dti.dk

Programme
EPD Danmark
www.epddanmark.dk

Declared products
Uncoated steel plate

Production site
NLMK DanSteel A/S, Frederiksvaerk, Denmark

Products use
Steel plates are used in many applications worldwide; shipbuilding, bridge-building, wind turbine tower production and pressure and boiler vessel production among others

Declared unit
1 metric ton of uncoated steel plate

Issued: 01-10-2018
Valid to: 01-10-2023

Basis of calculation
This EPD is developed in accordance with the European standard EN 15804.

Comparability
EPDs of construction products may not be comparable if they do not comply with the requirements in EN 15804. EPD data may not be comparable if the datasets used are not developed in accordance with EN 15804 and if the background systems are not based on the same database.

Validity
This EPD has been verified in accordance with ISO 14025 and is valid for 5 years from the date of issue.

Use
The intended use of an EPD is to communicate scientifically-based environmental information for construction products, for the purpose of assessing the environmental performance of buildings.

EPD type
☐Cradle-to-gate
☒Cradle-to-gate with options
☐Cradle-to-grave

CEN standard EN 15804 serves as the core PCR

Independent verification of the declaration and data, according to EN ISO 14025

☐ internal ☒ external

Third party verifier:

Linda Høibye

Henrik Fred Larsen
EPD Danmark

Life cycle stages and modules (MND = module not declared)																
Product			Construction process		Use							End of life				Beyond the system boundary
Raw material supply	Transport	Manufacturing	Transport	Installation process	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	De-construction demolition	Transport	Waste processing	Disposal	Re-use, recovery and 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	X	MND	X

Product information

Product description

This EPD is valid for hot rolled uncoated steel plates of varied grades and geometries, as well as different forms of delivery. Specific information on dimension tolerances, constructional data and mechanical and chemical properties can be found in the relevant standards.

Constructional data	Value	Unit
Density	7850	kg/m^3
Modulus of elasticity	210000	N/mm^2
Coefficient of thermal expansion	12	$10^{-6}K^{-1}$
Thermal Conductivity	48	W/(mK)
Melting point	1536	°C

Most of NLMK DanSteel A/S' steel plates are non-alloy steel products, except some boiler and pressure vessel grades and some weathering grades.

Iron is the main component of steel plates. Alloying elements are added in the form of ferroalloys or metal, the most common elements are manganese and aluminium. Microalloying elements may be present in the steel. The composition of these elements depends on the steel designation/grade. The table below shows the average composition of steel plates for alloying elements:

Alloying elements	C	Mn	Si	Cr	Cu	Ni	V	Ti	Nb	Al	Mo
Average content (%)	0.15	1.25	0.24	0.030	0.036	0.019	0.014	0.0018	0.014	0.040	0.0033

Representativity

This declaration, including data collection and the modelled foreground system including results, represents the production of non-coated steel plates on the production site located in Frederiksvaerk, Denmark. Product specific data are based on average values collected for the year 2017. The data originates from annual statements, measurements and calculations. Russian Slabs with an average of 3% external scrap are bought by NLMK DanSteel to produce the steel plates. The slabs are prefabricated by basic oxygen furnaces (BOF). The study uses a European (EU-28) steel slab production based on BF/BOF primary route (with up to 6% external scrap) as best approximation for this EPD.

Background data are based on GaBi ts databases. Most of the necessary life cycle inventories for the basic materials are available in the GABI 6 ts database. The last update of the database was in 2018 and used data from the GaBi ts databases is from 2014 to 2017 and is valid until 2020.

*BF: Blast furnace, BOF: Basic oxygen furnace

Dangerous substances

Steel plates does not contain substances listed in the "Candidate List of Substances of Very High Concern for Authorisation" in concentrations > 0,1%.

(http://echa.europa.eu/candidate-list-table)

Essential characteristics (CE)

Steel plates are produced according to product standards or codes in compliance with the costumer's order and specification. Each costumer order reflects specific needs in terms of material grades, mechanical properties, chemical composition or geometrical requirements and restrictions, and is set to account for and meet the relevant design and execution standards governing the structure. In addition, requirements relating to all stages of the structures lifecycle from ideation and design through manufacturing and in-service to decommissioning may also be reflected in the order. Such requirements might relate to corrosion resistance, visual appearance or special tolerances.

In European countries, for example, the Eurocode 3 series applies to design of buildings and civil engineering works manufactured in steel and assumes fabrication according to the associated execution standard, the EN 1090 Series. These standards outline specific product standards, such as the EN 10025 Series, from which structural steel products are often selected in design specifications and ordered.

Similarly, for fixed offshore structures in the oil & gas industry, design may be according to design standards such as the DNVGL-OS-C101, which assumes fabrication according to the associated execution standard DNVGL-OS-C401 and material selection of steel defined and produced according to DNVGL-OS-B101 as the base-case.

In addition, product requirements may also be influenced by national or local legislation or, in the maritime industry, by classification society rules. Examples of this may be found in the National Annexes issued by European countries, which lays down conditions for the implementation of a specific European Norm in that particular country and within a specified application field, e.g. for construction works in conformity with the building legislation.

Examples of typical product standards and national certifications:

- European standards /EN 10025-2 -3 -4 -5/, /EN10028-2 -3 -4/, /EN10225/
- ASTM and ASME international standards ASTM (ASME) (S)A36, (S)A516, (S)A572, A588
- Canadian standard association (CSA) /Gr 260W/, /Gr 300 W/, /Gr 350W/, /Gr 400W/
- Shipbuilding codes according to ABS, BV, DNVGL, LR, RINA

Plates produced according to the European Standard EN 10025 are also covered by the Construction Product Regulation (CPR) "*Regulation (EU) No 305/2011 of the European Parliament and the council of 9 March 2011 laying down harmonised conditions for the marketing of construction products and repealing Council Directive 89/106/EEC".* According to the regulation products need a declaration of performance. Declarations of performance can be found on NLMK DanSteel A/S' homepage:

http://www.dansteel.dk/7/596/Ydeevnedeklaration%20(DoP).html

Reference Service Life (RSL)

The documentation of the RSL is not required for the EPD since the entire life cycle is not declared (modules A1-A3 with D optional).

LCA background

Declared unit

The LCI and LCIA results in this EPD relates to 1 metric ton of an average non-coated steel plate produced by NLMK DanSteel A/S.

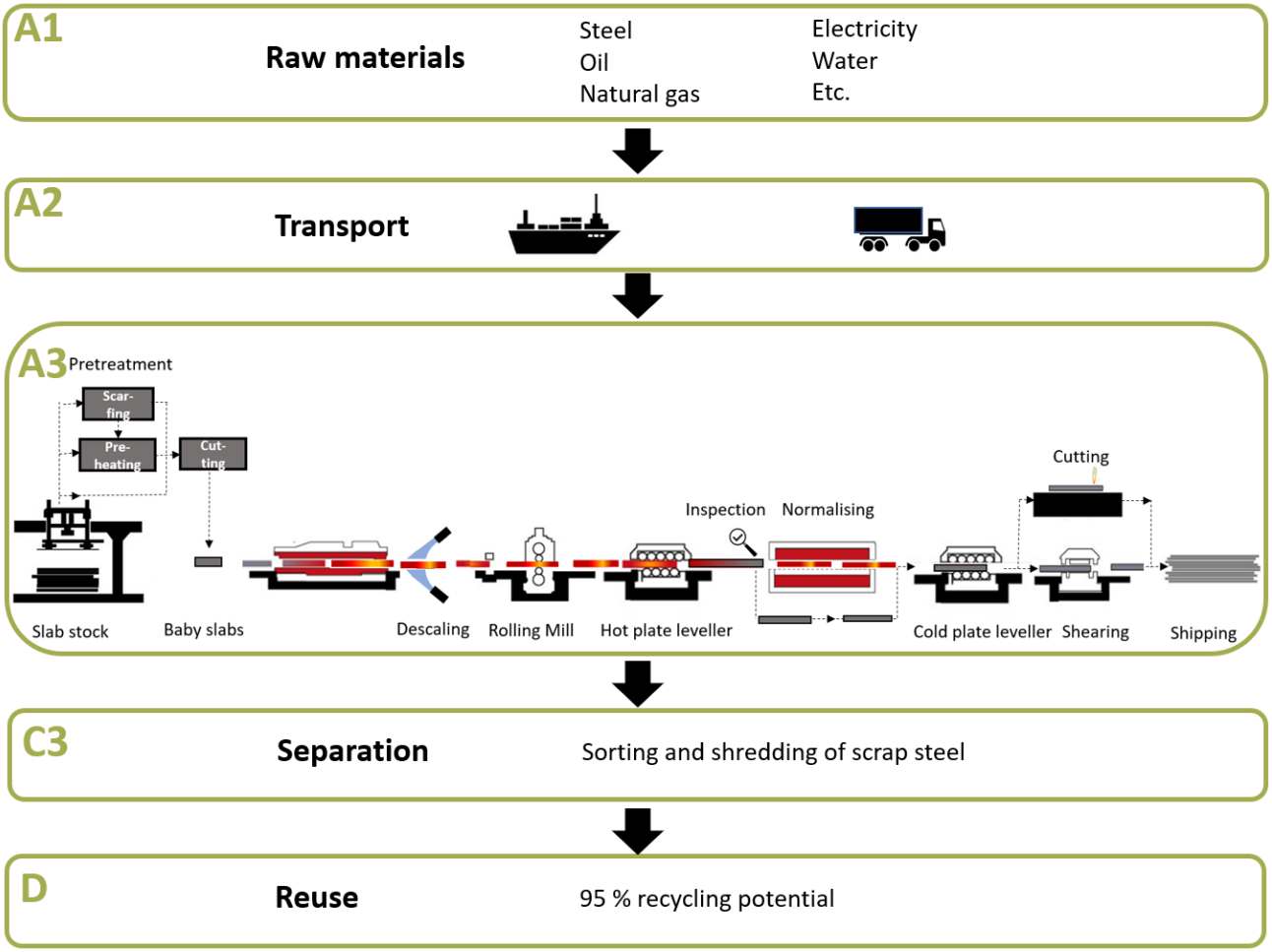
Name	Value	Unit
Declared unit	1	ton
Density	7850	kg/m^3
Conversion factor to 1 kg.	0.0001	-

The declaration is intended for use in business-to-business communication.

PCR

This EPD is developed according to the core rules for the product category of construction products in EN 15804 and the PRR's on Structural Steels and Building Metals from IBU.

Flow diagram



System boundaries

This EPD is based on a cradle-to-gate with options (A1-A3, C3, D)

The general rules for the exclusion of inputs and outputs follows the requirements in EN 15804, 6.3.5. where the total of neglected input flows per module may not exceed 5 % of energy usage and mass and 1 % of energy usage and mass for unit processes.

Data collection and measurements includes all processes, materials or emissions that are known to make a significant contribution to the environmental impact of producing steel plates at NLMK DanSteel A/S. All these emissions were considered in the model. Therefore, there has been no exclusion of inputs and outputs above these limits.

The following life cycle stages are considered:

- Product (A1-A3)
- End-of-life, waste processing (C3)
- Benefits and loads beyond the product system boundary (D)

Product stage (A1-A3) includes:

A1 – Extraction and processing of raw materials
A2 – Transport to the production site
A3 – Manufacturing processes

For the creation of all EPDs, the following processes were considered in detail for the production stages A1-A3 of construction steel products:

- Production of raw materials, production materials and auxiliary materials (Module A1)
- Transport of raw materials, semi-finished products and auxiliary materials to the production site (Module A2)
- Production of steel plate on-site, disposal of production residues and packaging of raw materials, also taking into account on-site emissions (Module A3).
- Scrap occurring during the production on-site is looped back to satisfy some of the demand for scrap input to the process.

The system boundary with nature is set to include those processes that provide the material and energy inputs into the system and the following manufacturing and transport processes up to the factory gate as well as the processing of any waste arising from those processes.

The inventory data include material, energy, auxiliary materials as well as water consumption and waste production (foreground data). The foreground data derive from NLMK DanSteel A/S and was collected by C7 Consulting A/S. Furthermore, LCA datasets (cradle to gate) for raw materials, energies, and other auxiliaries have been linked to the foreground data of the various stages of the life cycle (background data). The background data are provided by thinkstep AG from the GaBi ts databases.

Steel scrap that enters the product system is assumed to reach end of waste state after it has gone through a sorting and shredding process that takes place at demolition sites or waste processing facilities. Scrap emerging from these sites or facilities meets end of waste criteria, as it is a valuable commodity with a well-established existing market.

The steel plates are manufactured from slabs which are produced at Novolipetsk Steel (NLMK) in Russia. The slabs are transported by ship and train to NLMK DanSteel in Frederiksvaerk.

When the slabs are received they are cut up in smaller slab parts called "baby slabs" in a flame cutting process. Some slabs are preheated before flame-cutting to hinder crack formation during the cutting process. Before cutting, some baby slabs are pretreated in a scarfing machine to remove the outer 2-3 mm layer of steel. This hinders crack formation on the hot rolled plates. Hereafter, the baby slabs are led to the heating furnaces and from there to the rolling mill where the red-hot slab/plate is rolled back and forth through the working rolls until the plate has obtained the desired thickness, length and broadness.

In the furnace and rolling process, scale forms on the outer surface of the plates. Scale is removed by a descaling process where water is sprayed on the hot material at high pressure.

The hot rolled plate has a tendency to warp slightly and is, therefore, led to the hot plate leveller. Hereafter, the plate is cooled and then inspected. To obtain a higher quality, some plates are normalised. In the normalising furnaces, the plates are reheated to approx. 900 °C resulting in a fine grained steel structure which improves the strength of the steel. Afterwards, any warped plates are treated in a cold plate leveller to straighten each plate.

Finally, the plates are cut or sheared into a defined shape, length or broadness before being shipped to the customer.

End of life stage (C1-C4) includes:
C3 is included. This module takes into account the scrap preparation after initial sorting and shredding of the end-of-life steel.

Benefits and loads beyond the system boundary (D) includes:
Module D includes any declared benefits and loads from net flows leaving the product system that have not been allocated as co-products and that have passed the end-of-waste state in the form of reuse, recovery and/or recycling potentials.

Potential environmental benefits are given for the net scrap that is produced at the end of a final product's life. This net scrap is determined as follows:

Net scrap = Amount of steel recycled at end-of-life minus Scrap input from previous product life cycles.

After the collection and sorting stage, the demand for scrap input to the production is fulfilled by the amount of steel recycled (already sorted and shredded) at end-of-life. The steel scrap that is generated during production is reused in the slab production in a cycle "loop"; However, this externally recycled scrap is not used to calculate the potential environmental benefit or burden that is reported in Module D.

The value of scrap is calculated in accordance with the methodology developed by the World Steel Association "worldsteel" and is calculated based on the difference between a theoretical 100% primary steel (BF/BOF

route) and 100% secondary steel (EAF route), (see also /worldsteel Recycling Methodology/). Potential environmental benefits for recycling are calculated in module D.

LCA results

ENVIRONMENTAL IMPACTS PER [UNIT]				
Parameter	**Unit**	**A1-A3**	**C3**	**D**
GWP	[kg CO_2-eq.]	3,12E+03	2,48	-1,93E+03
ODP	[kg CFC11-eq.]	5,26E-10	7,00E-12	3,79E-10
AP	[kg SO_2-eq.]	7,55	0,00961	-4,65
EP	[kg PO_4^{3-}-eq.]	0,673	0,00119	-0,398
POCP	[kg ethene-eq.]	1,16	0,000698	-0,597
ADPE	[kg Sb-eq.]	0,000188	1,14E-06	0,000198
ADPF	[MJ]	2,74E+04	28,6	-1,53E+04
Caption	GWP = Global warming potential; ODP = Ozone depletion potential; AP = Acidification potential of soil and water; EP = Eutrophication potential; POCP = Photochemical ozone creation potential; ADPE = Abiotic depletion potential for non- fossil resources; ADPF = Abiotic depletion potential for fossil resources			

RESOURCE USE PER [UNIT]				
Parameter	**Unit**	**A1-A3**	**C3**	**D**
PERE	[MJ]	1,90E+03	1,20E+01	1,40E+03
PERM	[MJ]	0	-	-
PERT	[MJ]	1,90E+03	1,20E+01	1,40E+03
PENRE	[MJ]	2,83E+04	4,07E+01	-1,44E+04
PENRM	[MJ]	0	-	-
PENRT	[MJ]	2,83E+04	4,07E+01	-1,44E+04
SM	[kg]	0,00E+00	0,00E+00	1,01E+03
RSF	[MJ]	3,88E-19	1,62E-22	-4,06E-19
NRSF	[MJ]	0,0446	1,90E-21	-4,76E-18
FW	[m^3]	8,17	1,65E-02	0,675
Caption	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 material; RSF = Use of renewable secondary fuels; NRSF = Use of non- renewable secondary fuels; FW = Use of net fresh water			

WASTE CATEGORIES AND OUTPUT FLOWS PER [UNIT]				
Parameter	**Unit**	**A1-A3**	**C3**	**D**
HWD	[kg]	1,77E-05	3,28E-07	-1,01E-05
NHWD	[kg]	90,8	5,01E+01	-30,6
RWD	[kg]	0,357	4,79E-03	0,343
CRU	[kg]	0	0	0
MFR	[kg]	61,80	9,50E+02	0
MER	[kg]	-	-	-
EEE	[MJ]	-	-	-
EET	[MJ]	-	-	-
Caption	HWD = Hazardous waste disposed; NHWD = Non- hazardous waste disposed; RWD = Radioactive waste disposed; CRU = Components for re-use; MFR = Materials for recycling; MER = Materials for energy recovery; EEE = Exported electrical energy; EET = Exported thermal energy			

Additional information

Technical information on scenarios

End of life (C3)

Parameter	Value	Unit
Collected separately	1000	kg
Collected with mixed waste	-	kg
For reuse	-	kg
For recycling	950	kg
For energy recovery	-	kg
For final disposal	50	kg
Assumptions for scenario development	-	-

Indoor air

The EPD does not give out information on release of dangerous substances to indoor air because the horizontal standards on measurement of release of regulated dangerous substances from construction products, using harmonised test methods according to the provisions of the respective technical committees for European product standards, are not available.

Soil and water

The EPD does not give out information on release of dangerous substances to soil and water because the horizontal standards on measurement of release of regulated dangerous substances from construction products, using harmonised test methods according to the provisions of the respective technical committees for European product standards, are not available.

References

Publisher	epddanmark http://www.epddanmark.dk
Programme operator	Danish Technological Institute Sustainable Construction Kongsvang Allé 29 DK-8000 Aarhus C http://www.teknologisk.dk
LCA-practitioner	Thinkstep AG Paola Gamarra Hauptstraße 111 – 113 70771 Leinfelden – Echterdingen Phone: +49 711 341817 – 0
LCA software /background data	Thinkstep/GaBi databases version 6 2018
3rd party verifier	Linda Høibye, COWI

General programme instructions
Version 1.9
www.epddanmark.dk

EN 15804
DS/EN 15804 + A1:2013 - "Sustainability of construction works – Environmental product declarations – Core rules for the product category of construction products"

EN 15942
DS/EN 15942:2011 – " Sustainability of construction works – Environmental product declarations – Communication format business-to-business"

ISO 14025
DS/EN ISO 14025:2010 – " Environmental labels and declarations – Type III environmental declarations – Principles and procedures"

ISO 14040
DS/EN ISO 14040:2008 – " Environmental management – Life cycle assessment – Principles and framework"

ISO 14044
DS/EN ISO 14044:2008 – " Environmental management – Life cycle assessment – Requirements and guidelines"

PCR: Part B (Structural Steels)
Requirements on the EPD for Structural steels- Institut Bauen und Umwelt e.V., Königswinter (pub.): From the range of Environmental Product Declarations of Institute Construction and Environment e.V. (IBU) 2017

PCR: Part B (Building Metals)
Requirements on the EPD for Building metals- Institut Bauen und Umwelt e.V., Königswinter (pub.): From the range of Environmental Product Declarations of Institute Construction and Environment e.V. (IBU) 2017