ENVIRONMENTAL PRODUCT DECLARATION

as per *ISO 14025* and *EN 15804+A2*

Owner of the Declaration	thyssenkrupp Electrical Steel GmbH
Publisher	Institut Bauen und Umwelt e.V. (IBU)
Programme holder	Institut Bauen und Umwelt e.V. (IBU)
Declaration number	EPD-TKE-20240546-CBC1-EN
Issue date	29.01.2025
Valid to	28.01.2030

Grain oriented electrical steel

thyssenkrupp Electrical Steel AG

Institut Bauen und Umwelt e.V.

ECO PLATFORM EPD VERIFIED

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General Information

thyssenkrupp Electrical Steel AG

Programme holder

IBU – Institut Bauen und Umwelt e.V.
Hegelplatz 1
10117 Berlin
Germany

Declaration number

EPD-TKE-20240546-CBC1-EN

This declaration is based on the product category rules:

Structural steels, 01.08.2021
(PCR checked and approved by the SVR)

Issue date

29.01.2025

Valid to

28.01.2030

Dipl.-Ing. Hans Peters
(Chairman of Institut Bauen und Umwelt e.V.)

Florian Pronold
(Managing Director Institut Bauen und Umwelt e.V.)

Grain oriented electrical steel

Owner of the declaration

thyssenkrupp Electrical Steel GmbH
Kurt-Schumacher-Str. 95
45881 Gelsenkirchen
Germany

Declared product / declared unit

The declared unit is 1 metric ton of powercore® - grain oriented electrical steel

Scope:

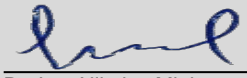
This environmental product declaration refers to grain oriented electrical steel produced at the facilities of thyssenkrupp Electrical steel in Gelsenkirchen and Isbergues.

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.

The EPD was created according to the specifications of EN 15804+A2. In the following, the standard will be simplified as *EN 15804*.

Verification

The standard EN 15804 serves as the core PCR
Independent verification of the declaration and data according to ISO 14025:2011
☐ internally ☒ externally



Dr.-Ing. Nikolay Minkov,
(Independent verifier)

Product

Product description/Product definition

The declared product is grain oriented electrical steel (GOES) in accordance with EN 10107 and is sold under the brand name powercore®. GOES reveals a very low specific magnetic loss and a high achievable working induction for a wide range of thickness between 0.18 and 0.35 mm. As for its material structure, GOES is characterized by an assembly of grains which sizes range from few up to around some 10 millimeters. The 'Goss' texture is the result of a complex metallurgical process. It reflects the abnormal growth of a few Goss grains in a fine primary recrystallized matrix during a box annealing process. These grains have a very sharp orientation in the rolling direction.

The different powercore® grades are characterized by the thickness and the maximum measured magnetic loss at a frequency of 50 Hz and an induction of 1.7 T along the strip. For example, the grade H 080-23 means powercore® with a nominal strip thickness of 0.23 mm and maximum magnetic loss of 0.80 W/kg. At thyssenkrupp Electrical Steel app. 80 % of the production is in thickness 0.23 mm, the remaining in thickness 0.20 and 0.27 mm.
An order neutral production takes place. After the last coating step the strips are assigned to the corresponding powercore® according the measured magnetic losses. These grades are:

0.20 mm	0.23 mm	0.27 mm
H 070-20	H 070-23	H 085-27
H 075-20	H 075-23	H 090-27
	H 078-23	H 095-27
	H 080-23	H 100-27
	H 085-23	
	H 090-23	
	H 100-23	

Consequently, the enviromental impact is independent from the magnetic grade.

No Declaration of Performance in accordance with the CPR or similar legal provisions is required to place powercore® on the market, as powercore® is a semi-finished product and therefore not a product that is ready for immediate use within the meaning of corresponding regulations

Application

Typical applications of powercore® are electrical machinery:

- Power transformers
- Distribution transformers
- Instrumental transformers
- Electromagnetic sensors
- Large power generator

Technical Data

Constructional data

Name	Value	Unit
Thickness	0,20 - 0.30	mm
Width	10 - 1020	mm
Coating System	EC-5-G on EC-2	

Performance values of the product according to the declaration of performance in relation to essential characteristics in accordance with EN 10107 and IEC 60404.8-7.

Base materials/Ancillary materials

The base material for producing grain oriented electrical steel is hot rolled steel strip with a thickness between 2 and 3 mm produced at thyssenkupp Steel Europe AG with a weight of around 22 t. The major characteristic is the comparable high Si content of around 3.2 %. Considering further alloys like Cr, Sn or Cu the total alloy content is < 4 %. The hot strip is delivered to the production plants of thyssenkrupp Electrical Steel in Isbergues (France) and Gelsenkirchen (Germany), where the material is subject to various annealing, cold rolling, coating and slitting steps. To ensure a sufficient electric insulation the steel is coated on both sites with a phosphate layer on top of a thin fosterite layer with a total thickness between 2 and 5 µ.

1) This product contains substances listed in the candidate list (date: 20.04.2024) exceeding 0.1 percentage by mass: **no**

2) This product contains other CMR substances in categories 1A or 1B which are not on the candidate list, exceeding 0.1 percentage by mass: **no**

3) Biocide products were added to this construction product or it has been treated with biocide products (this then concerns a treated product as defined by the (EU) Ordinance on Biocide Products No. 528/2012): **no**

Reference service life

Grain oriented electrical steel products can be used in various applications. Therefore, the lifetime of the products differs significantly and a reference service life cannot declared.

LCA: Calculation rules

Declared Unit

The declared unit is 1 ton of grain oriented electrical steel. Foreground data for the production are integrated into the LCA FE (GaBi) Software model for the production sites under study. Background data are taken from the LCA FE (GaBi) Database.

Declared unit and mass reference

Name	Value	Unit
Declared unit	1	t
Density	7650	kg/m^3
Conversion factor to 1 kg	1000	

Other declared units are allowed if the conversion is shown transparently.

For the calculation of the declared unit, all grades produced were included in the form of one production year. All input and output quantities for the production period under study (2021) were taken into account.
The analysis of different grade specifications identifies a variation of the product-related carbon footprint and the resource use (fossils) of a maximum of 5%. For eutrophication marine, eutrophication terrestrial and photochemical ozone formation, this interval amounts to a maximum of 7%, for acidification to a maximum of 13%. No relevant variation is given for eutrophication fresh water.
For complex-phase steel the variation in results is expected to be higher. The production volume for these types of steel products is << 5% of the total production.

System boundary
Type of the EPD: cradle-to-gate - with options: Modules A1-A3, Modules C1-C4 and Module D were considered.

Modules A1-A3 cover the production stage including the upstream burdens of purchased raw materials and energies, their transports and the process steps at the production sites under study. The electricity consumed is modelled via the residual grid mix with 0,847kg CO2 e/kWh for Germany and 0,0614kg CO2 e/kWh for France. The gas mix consumed is modelled with 0,0121kg CO2e/MJ for Germany and 0,0118kg CO2e/MJ for France.

Modules C1-C4 consider the dismantling of the considered product (C1), the transportation of the dismantled components to their final EoL destination (C2), the waste processing for reuse, recovery or recycling (C3) as well as the disposal (C4).

Module D refers to the End-of-Life, including recycling and/or reuse.

Geographic Representativeness
Land or region, in which the declared product system is manufactured, used or handled at the end of the product´s lifespan: Europe

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. The LCA FE (GaBi) background database (content version 2024.1) was used to calculate the LCA.

LCA: Scenarios and additional technical information

Characteristic product properties of biogenic carbon
The declared product does not include biogenic carbon.
There is no packaging considered within the given study.
The EPD covers four End of Life scenarios (SteelConstructioninfo; Sansom, M. / Meijer, J.):

- Scenario 0: 100 % Recycling
- Scenario 1: 100 % Reuse
- Scenario 2: 100 % Loss / Landfill
- Scenario 3: 88 % Recycling, 11 % Reuse and 1 % Loss

In case a **reference service life** according to applicable ISO standards is declared then the assumptions and in-use conditions underlying the determined RSL shall be declared. In addition, it shall be stated that the RSL applies to the reference conditions only.

The same holds for a service life declared by the manufacturer. Corresponding information related to in-use conditions needs not be provided if a service life taken from the list of service life by *BNB* is declared.

End of life (C1 - C4)

Name	Value	Unit
Landfilling - Scenario 0	0	kg
Landfilling - Scenario 1	0	kg
Landfilling - Scenario 2	1000	kg
Landfilling - Scenario 3	10	kg

Reuse, recovery and/or recycling potentials (D), relevant scenario information

Name	Value	Unit
Recycling - Scenario 0	1000	kg
Recycling - Scenario 1	0	kg
Recycling - Scenario 2	0	kg
Recycling - Scenario 3	880	kg
Reuse - Scenario 0	0	kg
Reuse - Scenario 1	1000	kg
Reuse - Scenario 2	0	kg
Reuse - Scenario 3	110	kg

LCA: Results

The following table contains the LCA results for a declared unit of 1 ton structural steel - grain oriented electrical steel.

DESCRIPTION OF THE SYSTEM BOUNDARY (X = INCLUDED IN LCA; MND = MODULE OR INDICATOR NOT DECLARED; MNR = MODULE NOT RELEVANT)

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	MNR	MNR	MNR	MND	MND	X	X	X	X	X

RESULTS OF THE LCA - ENVIRONMENTAL IMPACT according to EN 15804+A2: 1 ton grain oriented electrical steel

Parameter	Unit	A1-A3	C1	C2	C3	C3/1	C3/2	C3/3	C4	C4/1	C4/2	C4/3	D	D/1	D/2	D/3
GWP-total	kg CO_2 eq	4.25E+03	2.1E+01	3.18E+00	0	0	0	0	0	0	1.5E+01	1.5E-01	-1.95E+03	-4.25E+03	-2.19E+02	-2.18E+03
GWP-fossil	kg CO_2 eq	4.25E+03	2.1E+01	3.21E+00	0	0	0	0	0	0	1.5E+01	1.5E-01	-1.96E+03	-4.25E+03	-2.21E+02	-2.19E+03
GWP-biogenic	kg CO_2 eq	1.27E+00	-8.58E-02	-8.04E-02	0	0	0	0	0	0	-1.03E-01	-1.03E-03	1.15E+01	-1.27E+00	1.3E+00	1E+01
GWP-luluc	kg CO_2 eq	1.97E+00	1.16E-02	5.26E-02	0	0	0	0	0	0	8.98E-02	8.98E-04	-2.6E-01	-1.97E+00	-2.94E-02	-4.47E-01
ODP	kg CFC11 eq	2.84E-09	8.98E-12	4.61E-13	0	0	0	0	0	0	4.04E-11	4.04E-13	2.63E-09	-2.84E-09	2.96E-10	2E-09
AP	mol H^+ eq	6.36E+00	1.94E-01	4.16E-03	0	0	0	0	0	0	1.06E-01	1.06E-03	-4.79E+00	-6.36E+00	-5.4E-01	-4.92E+00
EP-freshwater	kg P eq	3.01E-03	1.06E-04	1.34E-05	0	0	0	0	0	0	3.4E-05	3.4E-07	-4.56E-04	-3.01E-03	-5.14E-05	-7.33E-04
EP-marine	kg N eq	1.95E+00	9.93E-02	1.5E-03	0	0	0	0	0	0	2.74E-02	2.74E-04	-7.69E-01	-1.95E+00	-8.68E-02	-8.92E-01
EP-terrestrial	mol N eq	2.12E+01	1.09E+00	1.78E-02	0	0	0	0	0	0	3.01E-01	3.01E-03	-6.89E+00	-2.12E+01	-7.77E-01	-8.41E+00
POCP	kg NMVOC eq	6.01E+00	2.7E-01	4.16E-03	0	0	0	0	0	0	8.37E-02	8.37E-04	-3.12E+00	-6.01E+00	-3.52E-01	-3.41E+00
ADPE	kg Sb eq	2.55E-02	2.79E-06	2.73E-07	0	0	0	0	0	0	9.7E-07	9.7E-09	-1.11E-02	-2.55E-02	-1.25E-03	-1.26E-02
ADPF	MJ	5.14E+04	2.9E+02	4.12E+01	0	0	0	0	0	0	1.97E+02	1.97E+00	-1.95E+04	-5.14E+04	-2.2E+03	-2.28E+04
WDP	m^3 world eq deprived	7.42E+02	1.31E+00	4.85E-02	0	0	0	0	0	0	1.71E+00	1.71E-02	-1.32E+02	-7.42E+02	-1.49E+01	-1.98E+02

GWP = Global warming potential; ODP = Depletion potential of the stratospheric ozone layer; AP = Acidification potential of land and water; EP = Eutrophication potential; POCP = Formation potential of tropospheric ozone photochemical oxidants; ADPE = Abiotic depletion potential for non-fossil resources; ADPF = Abiotic depletion potential for fossil resources; WDP = Water (user) deprivation potential)

RESULTS OF THE LCA - INDICATORS TO DESCRIBE RESOURCE USE according to EN 15804+A2: 1 ton grain oriented electrical steel

Parameter	Unit	A1-A3	C1	C2	C3	C3/1	C3/2	C3/3	C4	C4/1	C4/2	C4/3	D	D/1	D/2	D/3
PERE	MJ	3.85E+03	1.61E+01	3.55E+00	0	0	0	0	0	0	3.44E+01	3.44E-01	7.68E+02	-3.85E+03	8.67E+01	2.54E+02
PERM	MJ	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PERT	MJ	3.85E+03	1.61E+01	3.55E+00	0	0	0	0	0	0	3.44E+01	3.44E-01	7.68E+02	-3.85E+03	8.67E+01	2.54E+02
PENRE	MJ	5.14E+04	2.9E+02	4.12E+01	0	0	0	0	0	0	1.97E+02	1.97E+00	-1.95E+04	-5.14E+04	-2.2E+03	-2.28E+04
PENRM	MJ	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PENRT	MJ	5.14E+04	2.9E+02	4.12E+01	0	0	0	0	0	0	1.97E+02	1.97E+00	-1.95E+04	-5.14E+04	-2.2E+03	-2.28E+04
SM	kg	1.27E+02	0	0	0	0	0	0	0	0	0	0	1.13E+03	0	1.27E+02	0
RSF	MJ	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NRSF	MJ	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
FW	m^3	3.26E+01	4.34E-02	3.95E-03	0	0	0	0	0	0	5.23E-02	5.23E-04	-1.98E+02	-3.26E+01	-2.23E+01	-1.78E+02

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

RESULTS OF THE LCA – WASTE CATEGORIES AND OUTPUT FLOWS according to EN 15804+A2:
1 ton grain oriented electrical steel

Parameter	Unit	A1-A3	C1	C2	C3	C3/1	C3/2	C3/3	C4	C4/1	C4/2	C4/3	D	D/1	D/2	D/3
HWD	kg	1.37E-06	4.5E-08	1.58E-09	0	0	0	0	0	0	4.91E-08	4.91E-10	-1.46E-04	-1.37E-06	-1.64E-05	-1.28E-04
NHWD	kg	3.42E +01	3.28E-02	6.73E-03	0	0	0	0	0	0	1E+03	1E+01	2.36E+02	-3.42E +01	2.66E+01	2.04E+02
RWD	kg	3.55E +00	1.7E-03	7.51E-05	0	0	0	0	0	0	2.07E-03	2.07E-05	2.13E-03	-3.55E +00	2.4E-04	-3.89E-01
CRU	kg	0	0	0	0	1E+00	0	1.1E-01	0	0	0	0	0	0	0	0
MFR	kg	0	0	0	1E+00	0	0	8.8E-01	0	0	0	0	0	0	0	0
MER	kg	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
EEE	MJ	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
EET	MJ	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

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

RESULTS OF THE LCA – additional impact categories according to EN 15804+A2-optional:
1 ton grain oriented electrical steel

Parameter	Unit	A1-A3	C1	C2	C3	C3/1	C3/2	C3/3	C4	C4/1	C4/2	C4/3	D	D/1	D/2	D/3
PM	Disease incidence	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
IR	kBq U235 eq	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
ETP-fw	CTUe	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
HTP-c	CTUh	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
HTP-nc	CTUh	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
SQP	SQP	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

PM = Potential incidence of disease due to PM emissions; IR = Potential Human exposure efficiency relative to U235; ETP-fw = Potential comparative Toxic Unit for ecosystems; HTP-c = Potential comparative Toxic Unit for humans (cancerogenic); HTP-nc = Potential comparative Toxic Unit for humans (not cancerogenic); SQP = Potential soil quality index

Disclaimer 1 – for the indicator 'Potential Human exposure efficiency relative to U235'. 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 or radioactive waste disposal in underground facilities. Potential ionizing radiation from the soil, radon and from some construction materials is also not measured by this indicator.
Disclaimer 2 – for the indicators 'abiotic depletion potential for non-fossil resources', 'abiotic depletion potential for fossil resources', 'water (user) deprivation potential, deprivation-weighted water consumption', 'potential comparative toxic unit for ecosystems', 'potential comparative toxic unit for humans – cancerogenic', 'Potential comparative toxic unit for humans - not cancerogenic', 'potential soil quality index'. The results of this environmental impact indicator shall be used with care as the uncertainties on these results are high as there is limited experience with the indicator.

The results of the optional impact indicators are not declared in the EPD as the uncertainties on these results are high or as there is limited experience with these indicators.

Depending on the manufacturing site, the product-related carbon footprint varies by less than 14%. For acidification, eutrophication marine and terrestrial as well as photochemical ozone formation this interval amounts to a maximum of 9%, for resource use minerals and metals as well as fossils to a maximum of 3%. The highest variation is given for eutrophication freshwater with a maximum of 18%.

References

Standards

EN 10107
EN 10107:2022, Grain-oriented electrical steel strip and sheet delivered in the fully processed state

EN 15804
EN 15804:2012+A2:2019+AC:2021, Sustainability of construction works — Environmental Product Declarations — Core rules for the product category of construction products.

IEC 60404-8-7
IEC 60404-8-7:2020, Magnetic materials - Part 8-7: Specifications for individual materials - Cold-rolled grain-oriented electrical steel strip and sheet delivered in the fully-processed state

ISO 14025
EN ISO 14025:2011, Environmental labels and declarations — Type III environmental declarations — Principles and procedures.

Further References

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