Environmental Product Declaration

In accordance with ISO 14025:2006 for:

HOT ROLLED STAINLESS STEEL

Products: EN 1.4307 (304DL) - EN 1.4404 (316L) - EN 1.4509 (441AR)

from

ACCIAI SPECIALI TERNI S.p.A.

VIALE B. BRIN 218, 05100 TERNI - ITALY

Programme:	The International EPD® System, www.environdec.com
Programme operator:	EPD International AB
EPD registration number:	EPD-IES-0017039
Publication date:	2024-12-11
Valid until:	2029-12-05

An EPD should provide current information and may be updated if conditions change. The stated validity is therefore subject to the continued registration and publication at www.environdec.com

Programme information

Programme:	The International EPD® System
Address:	EPD International AB Box 210 60 - SE-100 31 Stockholm - Sweden
Website:	www.environdec.com
E-mail:	info@environdec.com

Accountabilities for PCR, LCA and independent, third-party verification
Product Category Rules (PCR)
PCR: Basic iron or steel products & special steels, except construction steel products*, 2015:03 version 2.1.1* *UN CPC 4112 and UN CPC 412*
PCR review was conducted by: Hundai Kara. The review panel may be contacted via info@environdec.com
Life Cycle Assessment (LCA)
LCA accountability: *Bureau Veritas Nexta srl*
Third-party verification
Independent third-party verification of the declaration and data, according to ISO 14025:2006, via: ☒ EPD verification by accredited certification body Third-party verification: DNV Business Assurance Italy s.r.l. is an approved certification body accountable for the third-party verification The certification body is accredited by: Accredia, Accreditation certificate n. 0015VV.
Procedure for follow-up of data during EPD validity involves third-party verifier: ☐ Yes ☒ No

The EPD owner has the sole ownership, liability, and responsibility for the EPD.

EPDs within the same product category but registered in different EPD programmes may not be comparable. For two EPDs to be comparable, they must be based on the same PCR (including the same version number) or be based on fully-aligned PCRs or versions of PCRs; cover products with identical functions, technical performances and use (e.g. identical declared/functional units); have equivalent system boundaries and descriptions of data; apply equivalent data quality requirements, methods of data collection, and allocation methods; apply identical cut-off rules and impact assessment methods (including the same version of characterisation factors); have equivalent content declarations; and be valid at the time of comparison. For further information about comparability, see ISO 14025.

Name and contact information of LCA practitioners:
Bureau Veritas Nexta Srl (www.nexta.bureauveritas.it)

Company information

Owner of the EPD: Acciai Speciali Terni S.p.A.

Contact: Emilio Santa Maria: emilio.santamaria@acciaiterni.it, +39 0744 4901.

Description of the organisation:
Acciai Speciali Terni S.p.A., called AST, is one of the world's leading producers of stainless-steel flat products, with 140 years of experience. In 1884, the businessman Vincenzo Breda founded the Società Alti Forni, Fonderie e Acciaierie di Terni, the first major Italian steel company. The company and the plants evolved year by year to the current Acciai Speciali Terni S.p.A., under the management of Arvedi Group, which acquired it from ThyssenKrupp in 2022.
Today, the core business of Acciai Speciali Terni S.p.A. is the production of flat rolled stainless steel products; in this segment, the company is a market leader in Italy and one of the four top producers in Europe. The manufacturing facilities are concentrated in Terni, spanning over 1,500,000 square meters, in which the company carries out the entire manufacturing cycle, from casting to packaging. Equipped with state-of-the-art technologies, the AST plants produce about one million tons of special steels annually. The company employs a direct workforce of more than 2,300 people, with several hundred additional workers involved in supporting services and related industries.
Acciai Speciali Terni S.p.A. is characterized by innovation and efficiency in its production process and product offerings. The company's product range is constantly improved and expanded. Today, the Terni plant produces a portfolio of austenitic, ferritic and martensitic hot rolled and cold rolled stainless steel flat products, with customized finishes, shapes and sizes. Customized products, innovative solutions and high-quality service are the hallmarks that have made their stainless steel a product of excellence across be the material of excellence for many market sectors all over the world.
The attention to the environment is a core priority for Acciai Speciali Terni, from production to processing innovations, from training to certifications. The Arvedi Group, of which Acciai Speciali Terni S.p.A. is a part, has an important investment plan focused on expanding production and achieving decarbonisation through the application of circular economy principles.

Product-related or management system-related certifications:
The tradition of Acciai Speciali Terni Group in managing its products according to a Quality System began with the acquisition of the Quality System Certificate ASME (the American Society of Mechanical Engineers). Nowadays, Acciai Speciali Terni S.p.A. has set up different management systems certified according to international standards, including ISO 9001:2015 (Quality), ISO 45001:2018 (Health&Safety), ISO 14001:2015 (Environment) and ISO 50001:2018 (Energy): for each of them AST owns a certificate issued by a third-party certification body. Furthermore, Acciai Speciali Terni S.p.A has been certified according to the ResponsibleSteel™ standard (AST is the first Italian steel producer certified according to this standard).

Name and location of production site:
ACCIAI SPECIALI TERNI S.p.A.
Viale B. Brin 218
05100 Terni - Italy

Product information

Products name: Hot rolled steel, with different composition:

- EN 1.4307 (304DL)
- EN 1.4404 (316L)
- EN 1.4509 (441AR)

Products description and identification:

The austenitic steel 304DL (304DL – EN 1.4307 – ISO X2CrNi 18-9 – UNS S30403 – Hot Rolled 1D) is a variant of 304 steel, featuring reduced carbon content for improved stability and resistance to intergranular corrosion, while maintaining the same mechanical and cold formability characteristics offered by 304.

The technical and general characteristics are:

Density	7900	kg/m^3
Coefficient of thermal expansion	14	10^{-6} K^{-1}
Thermal conductivity	19	W/(mK)
Modulus of elasticity	205	GPa
Melting point	1455	°C
Proof strength Rp0.2	200-240	MPa
Tensile strength Rm	520-700	MPa
Elongation A	>45	%
Product Thickness	1.84 – 6.50	mm
Product Width	1000 – 1520	mm

The steel 316L (316L – EN 1.4404 – ISO X2CrNiMo 17-12-2 – UNS S31603 – Hot Rolled 1D) is an austenitic stainless steel containing chromium, nickel and molybdenum. The general characteristics of the product are similar to those of 304 stainless steels (excellent ductility and weldability) with increased resistance against generalised pitting and crevice corrosion. The features of this grade make it suitable to be used in aggressive environments and adopted in a wide range of temperatures: from cryogenic up to 800-850°C. The grade variant with a low carbon content (316L) limits carbide precipitation during welding.

The technical and general characteristics are:

Density	7900	kg/m^3
Coefficient of thermal expansion	14	10^{-6} K^{-1}
Thermal conductivity	19	W/(mK)
Modulus of elasticity	205	GPa
Melting point	1450	°C
Proof strength Rp0.2	220-260	MPa
Tensile strength Rm	530-680	MPa
Elongation A	>40	%
Product Thickness	2.50 – 6.50	mm
Product Width	1000 – 1520	mm

The steel 441 (441LI – EN 1.4509 – ISO X2CrTiNb 18 – UNS S43940 – Hot Rolled 1D) is a ferritic stainless steel containing Ti and Nb, suitable for a wide range of uses due to the dual stabilization. 441 stainless steel combines high mechanical and corrosion resistance both at room temperature and at high temperatures, together with good ductility at room temperature. The high level of purity, together with stabilisation, also guarantees excellent weldability of 441 stainless steel without requiring post-weld heat treatments.

The technical and general characteristics are:

Density	7700	kg/m^3
Coefficient of thermal expansion	14	10^{-6} K^{-1}
Thermal conductivity	25	W/(mK)
Modulus of elasticity	220	GPa
Melting point	1500	°C
Proof strength Rp0.2	230-250	MPa
Tensile strength Rm	430-630	MPa
Elongation A	>18	%
Product Thickness	2.00 – 6.50	mm
Product Width	1000 – 1520	mm

UN CPC code: 4121 – Flat-rolled products of steel, not further worked than hot-rolled (for hot-rolled products)

Geographical scope: Global

LCA information

Functional unit / declared unit: 1 ton of hot rolled steel. The possible compositions are:

- EN 1.4307 (304DL)
- EN 1.4404 (316L)
- EN 1.4509 (441AR)

Reference service life: not applicable

Time representativeness: primary data refer to 2023 year. The generic data has been updated in 2023 (Ecoinvent 3.9.1).

Geographical representativeness: primary data are obtained from Acciai Speciali Terni S.p.A. management system. The secondary data are obtained by database Ecoinvent 3.9.1 (RER or GLO records).

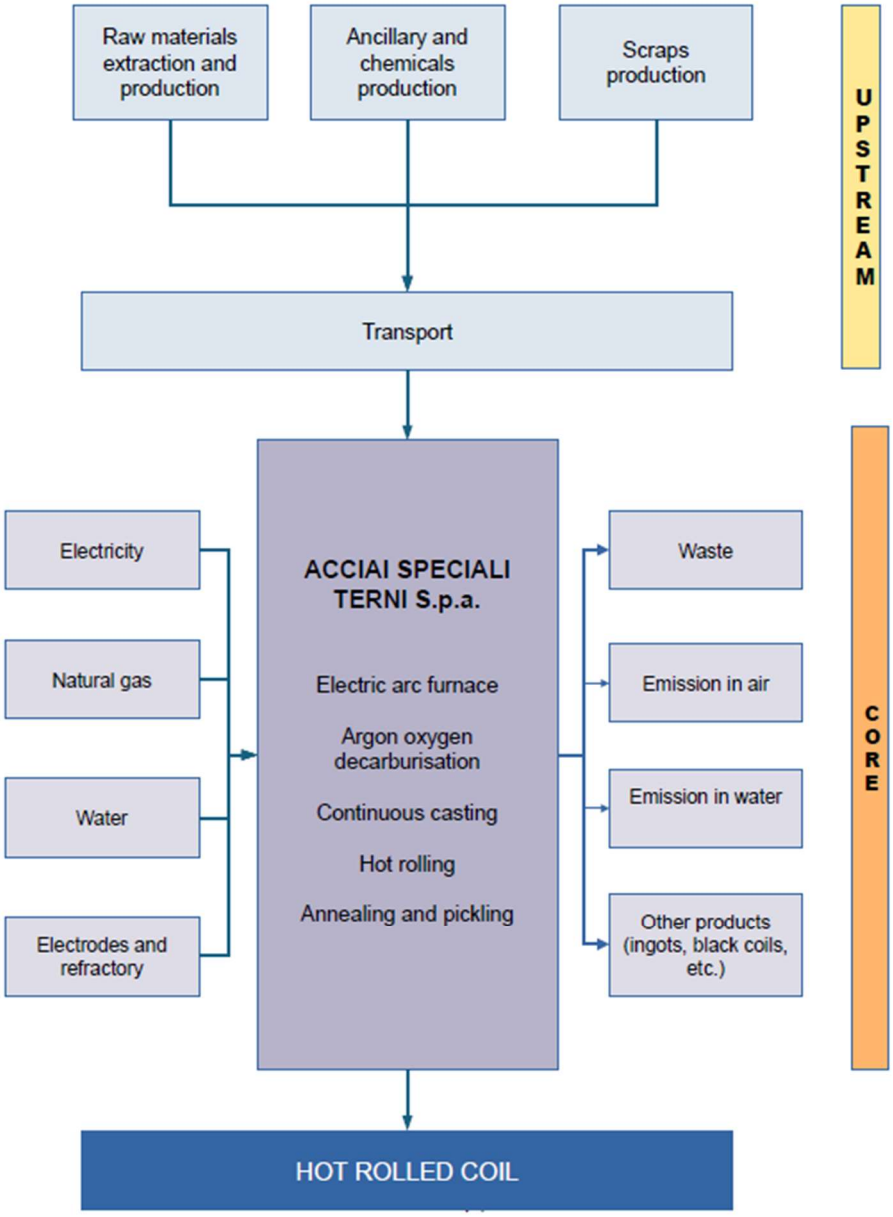
Technological representativeness: primary data are obtained from processes of Acciai Speciali Terni S.p.A under study. The secondary data are obtained from database for similar technology of Acciai Speciali Terni S.p.A materials or processes.

Database(s) and LCA software used: for the elaboration of data SimaPro v. 9.5.0.2; the used database is Ecoinvent 3.9.1.

Data quality

The analysis of the quality of both primary and secondary data used in the study was carried following the criteria of Appendix E2 of the standard EN 15804.

System diagram:



Description of system boundaries: cradle-to-gate

Excluded lifecycle stages: Downstream processes (indicated in PCR)

Additional information:

- The allocation is applied in the LCA study: when necessary, mass allocation is used.
- Cut-off: at least 99% of the energy and materials has been introduced, as well as 99% of the total use of energy and materials.
- The polluter payer principle has been followed.
- The long-term emissions have not been included.
- The following processes have not been included since their impacts are not significant:
    - Environmental impact from infrastructure, construction, production equipment, and tools that are not directly consumed in the production process.
    - Personnel-related impacts, such as transportation to and from work.

The verifier and the program operator do not make any claim nor have any responsibility of the legality of the product.

The estimated impact results are only relative statements which do not indicate the end points of the impact categories, exceeding threshold values, safety margins or risks.

Content declaration

Product composition - EN 1.4307 (304DL) hot rolled steel

Composition	%
C	<0,03
Cr	18-18,4
Ni	8-8,2
Mo	<0,5
Si	0,3-0,55
Mn	1,6-1,9

The product does not contain PBT/vPvB substances ≥ 0.1% evaluated in accordance with Annex XIII of REACH and does not contain substances listed on the REACH candidate list.

Product composition - EN 1.4404 (316L) hot rolled steel

Composition	%
C	<0,03
Cr	16,5-16,9
Ni	10-10,4
Mo	2-2,2
Si	0,3-0,7
Mn	0,8-1,3

The product does not contain PBT/vPvB substances ≥ 0.1% evaluated in accordance with Annex XIII of REACH and does not contain substances listed on the REACH candidate list.

Product composition - EN 1.4509 (441AR) hot rolled steel

Composition	%
C	<0,025
Cr	17,5-18,5
Ni	<0,5
Mo	<0,2
Si	0,3-0,55
Mn	<0,4
Nb	>0,3+3C
Ti	0,1-0,3

The product does not contain PBT/vPvB substances ≥ 0.1% evaluated in accordance with Annex XIII of REACH and does not contain substances listed on the REACH candidate list.

Packaging

Distribution packaging: not relevant
Consumer packaging: not relevant

Results of the environmental performance indicators

Impact category indicators

The following results are valid for 1 ton of **EN 1.4307 (304DL) hot rolled steel**

PARAMETER		UNIT	Upstream	Core	TOTAL
Global warming potential (GWP)	Fossil	kg CO_2 eq.	9,99E+02	1,02E+03	2,02E+03
	Biogenic	kg CO_2 eq.	2,99E+00	1,48E+00	4,47E+00
	Land use and land transformation	kg CO_2 eq.	1,62E+00	3,84E-02	1,66E+00
	TOTAL	kg CO_2 eq.	1,00E+03	1,02E+03	2,03E+03
Ozone layer depletion (ODP)		kg CFC 11 eq.	1,09E-05	2,25E-05	3,34E-05
Acidification potential (AP)		mol H^+ eq.	1,67E+01	1,80E+00	1,85E+01
Eutrophication potential (EP)	Aquatic freshwater	kg P eq.	5,97E-02	1,00E-02	6,97E-02
	Aquatic marine	kg N eq.	1,30E+00	3,62E-01	1,66E+00
	Aquatic terrestrial	mol N eq.	1,45E+01	4,06E+00	1,85E+01
Photochemical oxidant creation potential (POCP)		kg NMVOC eq.	5,27E+00	2,25E+00	7,52E+00
Abiotic depletion potential (ADP)*	Metals and minerals	kg Sb eq.	3,76E-02	1,07E-05	3,76E-02
	Fossil resources	MJ, net calorific value	1,34E+04	1,37E+04	2,71E+04
Water deprivation potential (WDP)*		m^3 world eq. deprived	5,49E+02	0,00E+00	5,49E+02

** Disclaimer: The results of this environmental impact indicator shall be used with care as the uncertainties of these results are high or as there is limited experience with the indicator.*

The following results are valid for 1 ton of **EN 1.4404 (316L) hot rolled steel**

PARAMETER		UNIT	Upstream	Core	TOTAL
Global warming potential (GWP)	Fossil	kg CO_2 eq.	1,87E+03	1,02E+03	2,89E+03
	Biogenic	kg CO_2 eq.	4,86E+00	1,48E+00	6,34E+00
	Land use and land transformation	kg CO_2 eq.	2,48E+00	3,84E-02	2,52E+00
	TOTAL	kg CO_2 eq.	1,87E+03	1,02E+03	2,90E+03
Ozone layer depletion (ODP)		kg CFC 11 eq.	1,76E-05	2,25E-05	4,01E-05
Acidification potential (AP)		mol H^+ eq.	3,02E+01	1,80E+00	3,20E+01
Eutrophication potential (EP)	Aquatic freshwater	kg P eq.	1,55E-01	1,00E-02	1,65E-01
	Aquatic marine	kg N eq.	2,75E+00	3,62E-01	3,11E+00
	Aquatic terrestrial	mol N eq.	3,36E+01	4,06E+00	3,77E+01
Photochemical oxidant creation potential (POCP)		kg NMVOC eq.	1,04E+01	2,25E+00	1,26E+01
Abiotic depletion potential (ADP)*	Metals and minerals	kg Sb eq.	4,38E-01	1,07E-05	4,38E-01
	Fossil resources	MJ, net calorific value	2,35E+04	1,37E+04	3,72E+04
Water deprivation potential (WDP)*		m^3 world eq. deprived	9,13E+02	0,00E+00	9,13E+02

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The following results are valid for 1 ton of **EN 1.4509 (441AR) hot rolled steel**

PARAMETER		UNIT	Upstream	Core	TOTAL
Global warming potential (GWP)	Fossil	kg CO_2 eq.	2,74E+03	1,02E+03	3,76E+03
	Biogenic	kg CO_2 eq.	7,77E+00	1,48E+00	9,25E+00
	Land use and land transformation	kg CO_2 eq.	4,97E+00	3,84E-02	5,01E+00
	TOTAL	kg CO_2 eq.	2,75E+03	1,02E+03	3,77E+03
Ozone layer depletion (ODP)		kg CFC 11 eq.	3,20E-05	2,25E-05	5,45E-05
Acidification potential (AP)		mol H^+ eq.	1,97E+01	1,80E+00	2,15E+01
Eutrophication potential (EP)	Aquatic freshwater	kg P eq.	1,81E-01	1,00E-02	1,91E-01
	Aquatic marine	kg N eq.	2,95E+00	3,62E-01	3,31E+00
	Aquatic terrestrial	mol N eq.	3,30E+01	4,06E+00	3,70E+01
Photochemical oxidant creation potential (POCP)		kg NMVOC eq.	1,06E+01	2,25E+00	1,29E+01
Abiotic depletion potential (ADP)*	Metals and minerals	kg Sb eq.	1,04E-01	1,07E-05	1,04E-01
	Fossil resources	MJ, net calorific value	3,67E+04	1,37E+04	5,04E+04
Water deprivation potential (WDP)*		m^3 world eq. deprived	1,26E+03	0,00E+00	1,26E+03

** Disclaimer: The results of this environmental impact indicator shall be used with care as the uncertainties of these results are high or as there is limited experience with the indicator.*

Resource use indicators

The following results are valid for 1 ton of **EN 1.4307 (304DL) hot rolled steel**

PARAMETER		UNIT	Upstream	Core	TOTAL
Primary energy resources – Renewable	Use as energy carrier	MJ, net calorific value	2,54E+03	2,84E+02	2,83E+03
	Used as raw materials	MJ, net calorific value	0,00E+00	0,00E+00	0,00E+00
	TOTAL	MJ, net calorific value	2,54E+03	2,84E+02	2,83E+03
Primary energy resources – Non-renewable	Use as energy carrier	MJ, net calorific value	1,34E+04	1,37E+04	2,71E+04
	Used as raw materials	MJ, net calorific value	7,49E+02	7,09E+01	8,20E+02
	TOTAL	MJ, net calorific value	1,42E+04	1,38E+04	2,80E+04
Secondary material		kg	1,06E+03	0,00E+00	1,06E+03
Renewable secondary fuels		MJ, net calorific value	0,00E+00	0,00E+00	0,00E+00
Non-renewable secondary fuels		MJ, net calorific value	0,00E+00	0,00E+00	0,00E+00
Net use of fresh water		m^3	6,12E+00	1,70E+02	1,76E+02

The following results are valid for 1 ton of **EN 1.4404 (316L) hot rolled steel**

PARAMETER		UNIT	Upstream	Core	TOTAL
Primary energy resources – Renewable	Use as energy carrier	MJ, net calorific value	5,41E+03	2,84E+02	5,69E+03
	Used as raw materials	MJ, net calorific value	0,00E+00	0,00E+00	0,00E+00
	TOTAL	MJ, net calorific value	5,41E+03	2,84E+02	5,69E+03
Primary energy resources – Non-renewable	Use as energy carrier	MJ, net calorific value	2,35E+04	1,37E+04	3,72E+04
	Used as raw materials	MJ, net calorific value	7,90E+02	7,09E+01	8,61E+02
	TOTAL	MJ, net calorific value	2,43E+04	1,38E+04	3,81E+04
Secondary material		kg	9,98E+02	0,00E+00	9,98E+02
Renewable secondary fuels		MJ, net calorific value	0,00E+00	0,00E+00	0,00E+00
Non-renewable secondary fuels		MJ, net calorific value	0,00E+00	0,00E+00	0,00E+00
Net use of fresh water		m^3	1,45E+01	1,70E+02	1,84E+02

The following results are valid for 1 ton of **EN 1.4509 (441AR) hot rolled steel**

PARAMETER		UNIT	Upstream	Core	TOTAL
Primary energy resources – Renewable	Use as energy carrier	MJ, net calorific value	3,23E+03	2,84E+02	3,51E+03
	Used as raw materials	MJ, net calorific value	0,00E+00	0,00E+00	0,00E+00
	TOTAL	MJ, net calorific value	3,23E+03	2,84E+02	3,51E+03
Primary energy resources – Non-renewable	Use as energy carrier	MJ, net calorific value	3,67E+04	1,37E+04	5,04E+04
	Used as raw materials	MJ, net calorific value	8,85E+02	7,09E+01	9,56E+02
	TOTAL	MJ, net calorific value	3,75E+04	1,38E+04	5,14E+04
Secondary material		kg	9,77E+02	0,00E+00	9,77E+02
Renewable secondary fuels		MJ, net calorific value	0,00E+00	0,00E+00	0,00E+00
Non-renewable secondary fuels		MJ, net calorific value	0,00E+00	0,00E+00	0,00E+00
Net use of fresh water		m^3	1,18E+01	1,70E+02	1,81E+02

Waste indicators

The following results are valid for 1 ton of **EN 1.4307 (304DL) hot rolled steel**

PARAMETER	UNIT	Upstream	Core	TOTAL
Hazardous waste disposed	kg	1,35E-01	5,09E-02	1,86E-01
Non-hazardous waste disposed	kg	4,93E+02	3,22E+01	5,25E+02
Radioactive waste disposed	kg	2,85E-02	1,36E-02	4,21E-02

The following results are valid for 1 ton of **EN 1.4404 (316L) hot rolled steel**

PARAMETER	UNIT	Upstream	Core	TOTAL
Hazardous waste disposed	kg	2,23E-01	5,09E-02	2,74E-01
Non-hazardous waste disposed	kg	1,45E+03	3,22E+01	1,48E+03
Radioactive waste disposed	kg	4,34E-02	1,36E-02	5,71E-02

The following results are valid for 1 ton of **EN 1.4509 (441AR) hot rolled steel**

PARAMETER	UNIT	Upstream	Core	TOTAL
Hazardous waste disposed	kg	5,89E-01	5,09E-02	6,39E-01
Non-hazardous waste disposed	kg	7,28E+02	3,22E+01	7,60E+02
Radioactive waste disposed	kg	9,33E-02	1,36E-02	1,07E-01

Output flow indicators

The following results are valid for 1 ton of **EN 1.4307 (304DL) hot rolled steel**

PARAMETER	UNIT	Upstream	Core	TOTAL
Components for reuse	kg	0,00E+00	0,00E+00	0,00E+00
Material for recycling	kg	0,00E+00	1,03E+01	1,03E+01
Materials for energy recovery	kg	0,00E+00	0,00E+00	0,00E+00
Exported energy, electricity	MJ per energy carrier	0,00E+00	0,00E+00	0,00E+00
Exported energy, thermal	MJ per energy carrier	0,00E+00	0,00E+00	0,00E+00

The following results are valid for 1 ton of **EN 1.4404 (316L) hot rolled steel**

PARAMETER	UNIT	Upstream	Core	TOTAL
Components for reuse	kg	0,00E+00	0,00E+00	0,00E+00
Material for recycling	kg	0,00E+00	1,03E+01	1,03E+01
Materials for energy recovery	kg	0,00E+00	0,00E+00	0,00E+00
Exported energy, electricity	MJ per energy carrier	0,00E+00	0,00E+00	0,00E+00
Exported energy, thermal	MJ per energy carrier	0,00E+00	0,00E+00	0,00E+00

The following results are valid for 1 ton of **EN 1.4509 (441AR) hot rolled steel**

PARAMETER	UNIT	Upstream	Core	TOTAL
Components for reuse	kg	0,00E+00	0,00E+00	0,00E+00
Material for recycling	kg	0,00E+00	1,03E+01	1,03E+01
Materials for energy recovery	kg	0,00E+00	0,00E+00	0,00E+00
Exported energy, electricity	MJ per energy carrier	0,00E+00	0,00E+00	0,00E+00
Exported energy, thermal	MJ per energy carrier	0,00E+00	0,00E+00	0,00E+00

Additional environmental, social and economic information

No further information is provided.
This document is the first emission of EPD.

References

- General Programme Instructions of the International EPD® System. Version 3.0.1
- PCR 2015:03 Basic iron or steel products & special steel. Except construction steel products (version 2.1.1)
- ISO 14040:2006 Environmental management - Life Cycle Assessment - Principles and framework
- ISO 14044:2006 Environmental management - Life Cycle Assessment-Requirements and guidelines
- ISO 14025:2010 Environmental labels and declarations-Type III Environmental Declarations-Principles and procedures
- Project report: Hot rolled coil and Cold rolled coil, rev. 3 of 20/09/2024
- Ecoinvent 3.9.1