ENVIRONMENTAL PRODUCT DECLARATION

as per ISO 14025 and EN 15804

Owner of the Declaration	**Outokumpu Oyj**
Programme holder	Institut Bauen und Umwelt e.V. (IBU)
Publisher	Institut Bauen und Umwelt e.V. (IBU)
Declaration number	EPD-OTO-20140001-IBD1-EN
Issue date	03.03.2014
Valid to	02.03.2019

Hot Rolled Stainless Steel

Outokumpu Oyj

Institut Bauen und Umwelt e.V.

www.bau-umwelt.com / https://epd-online.com

1. General Information

Outokumpu Oyj	Hot Rolled Stainless Steel
Programme holder IBU - Institut Bauen und Umwelt e.V. Panoramastr. 1 10178 Berlin Germany	**Owner of the Declaration** Outokumpu Oyj Riihitontuntie 7 FI-02201 ESPOO Finland
Declaration number EPD-OTO-20140001-IBD1-EN	**Declared product / Declared unit** This EPD applies to 1 ton of hot rolled stainless steel product. It covers steel delivered as sheet or as plate for various applications for building and civil work.
This Declaration is based on the Product Category Rules: Structural steels, 07-2012 (PCR tested and approved by the independent expert committee)	**Scope:** The declaration applies to 1 ton of hot rolled stainless steel product produced by Outokumpu. The Life Cycle Assessment is based on data from the following Outokumpu production plants: - Outokumpu Stainless AB, Avesta, Sweden - Outokumpu Stainless AB, Degerfors, Sweden - Outokumpu Stainless AB, Nyby, Torshalla, Sweden - Outokumpu Stainless Oy, Tornio, Finland - Outokumpu Nirosta GmbH, Dillenburg, Germany - Outokumpu Nirosta GmbH, Krefeld, Germany - SMACC Melting Shop, Sheffield, UK Production has been modeled using annual production data from 2011. Where required averaging is based on production output from each site.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.
Issue date 03.03.2014	
Valid to 02.03.2019	**Verification** The CEN Norm EN 15804 serves as the core PCR Independent verification of the declaration and data according to ISO 14025 ☐ internally ☒ externally
Prof. Dr.-Ing. Horst J. Bossenmayer (President of Institut Bauen und Umwelt e.V.)	
Dr. Burkhart Lehmann (Managing Director IBU)	Mr Olivier Muller (Independent tester appointed by SVA)

2. Product

2.1 Product description

This EPD describes hot rolled stainless steel products produced by Outokumpu Oyj. Hot rolled products are supplied as coil or as plate. Hot rolled stainless steel has excellent durability and strength. A number of sheet and plate widths, lengths and thicknesses are available to meet the various design specifications and requirements. Several surface finishes are available, e.g. pickled, brushed and ground surface. This EPD is applicable to homogeneous Outokumpu hot rolled products which are used in the construction and building industry.

2.2 Application

Hot rolled products are used in a wide range of applications in building and construction. Typical applications are load bearing structures such as heavy transport, bridges and floodgates, building fixings, traffic barriers, and façade components.

2.3 Technical Data

Constructional data

Name	Value	Unit
Density	7900	kg/m^3
Modulus of elasticity	205	N/mm^2
Coefficient of thermal expansion	13.4	$10^{-6}K^{-1}$
Thermal conductivity	21	W/(mK)

2.4 Placing on the market / Application rules

For the marketing in the EU/EFTA the Regulation (EU) No 305/2011 dated from 9 March 2011 applies. The

products need a Declaration of Performance taking into consideration /EN 10088:2009/ Stainless steels/ and the CE-marking.

For the application and use the respective national provisions apply.

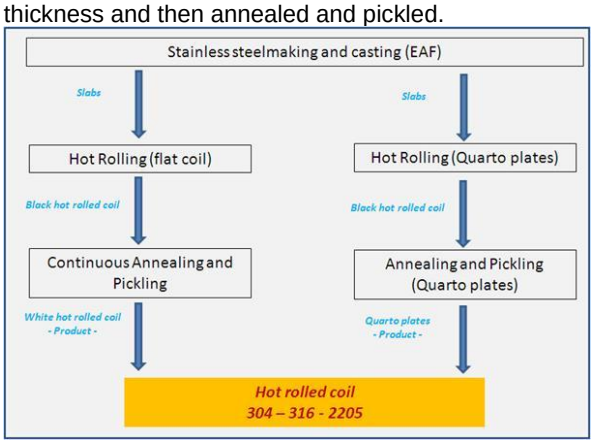
The products are certified in accordance with product standards:
/**EN 10088:2009**/, Stainless steels
/**EN 10028:2007**/, Flat products made of steels for pressure purposes – Stainless steels
/**ASTM A240**/, Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications
/**ASME IID**/, Materials
/**JIS G4304: 2012**/, Stainless steel plate

More detailed information on technical properties in the Outokumpu brochure “Steel Grades, Properties and Global Standards”.

2.5 Delivery status
Hot Rolled 1D and 1G surface finish condition according to /**EN 10088-1**/ and in accordance with /**EN 10204**/. The dimensions of the declared product may vary according to the final use.

2.6 Base materials / Ancillary materials
Manufacturing is based on recycling and ferrous scrap (predominantly stainless steel scrap) is used as a major raw material. Alloying elements are also added as ferroalloys or metals. The most common alloying elements are chromium, nickel, molybdenum, manganese and silicon. Other elements, for example nitrogen, niobium and titanium may also be present in the stainless steel. The presence and rates of these alloying elements depend on the stainless steel designation as set out in /**EN 10088-1**/.All stainless steels contain at least 10.5 % chromium.
Substances listed on the “Candidate List of Substances of Very High Concern for Authorisation” by the European Chemicals Agency are not contained in the stainless steel in declarable quantities.

2.7 Manufacture
The steel scrap is melted in an electric arc furnace to obtain a steel melt. The liquid steel is further refined (adjustment of sulphur, carbon and phosphorous) and alloyed to give the stainless steel the required characteristics. The molten steel is then cast into semi-finished steel products like slabs or billets. The semi-finished steel products are hot rolled to the desired thickness and then annealed and pickled.



2.8 Environment and health during manufacturing
Environmental, occupational health and safety and quality management are in accordance with /**ISO 14001**/, /**ISO 9001**/ and /**OHSAS 18001**/

2.9 Product processing/Installation
Processing and installation of the steel coil, sheet or plate has to be carried out according to generally recognized engineering rules and the manufacturer’s recommendation depending on the respective application.
Eurocodes /**EC3**/ and /**EC4**/ apply to the design and construction. They include the requirements regarding performance, durability and fire resistance of steel structures. During handling and use of the products, normal occupational safety measures should be applied. Instructions from the manufacturer concerning welding as well as hot and cold forming are to be followed.
Under normal conditions there will be no significant environmental impact to water, air or soil.
Residual material like steel scrap should be collected as it is 100% recyclable.

2.10 Packaging
Stainless sheets and plates are usually delivered with paper to protect the surface. This paper has been included in the EPD. In some cases, wooden pallets may be used for truck transport, although these have not been included in the EPD.

2.11 Condition of use
The maintenance requirements depend on the specific design and application, but typically stainless steel only requires a minimum of maintenance, for example, washing with mild detergents to maintain the product’s appearance.

2.12 Environment and health during use
Under normal conditions of use, stainless steel products do not cause adverse health effects and stainless steel does not release volatile organic compounds (VOCs) to indoor air.
Similarly no significant environmental impact to water, air or soil is expected, due to the extremely low metal release from stainless steel and the low maintenance need.

2.13 Reference service life
Service life is dependent upon physical and mechanical service conditions. Correct alloy designation choice can satisfy a required service life.

2.14 Extraordinary effects

Fire
Structural steel products meet the requirements of building material safety class A1 (i.e. non-flammable according to /**EN 13501-1**/).

Water
In the event of unforeseeable exposure to water caused by sudden flooding, no risks to the environment or human health are expected to occur.

Mechanical destruction
In the event of mechanical destruction, no risks to the environment or human health are expected to occur.

2.15 Re-use phase
Stainless steel panels and structures are not generally reused at end-of-life. Reuse is possible and could take place providing that the reused component was able to meet the technical specifications required. Stainless steel is more commonly recycled as material recovered at end-of-life can be recycled to the same quality of steel without loss of properties.

2.16 Disposal
Stainless steel scrap is a valuable resource with well-established recycling routes. Disposal is not recommended, but has no adverse environmental impact.
The /**European Waste Catalogue/** code for iron and steel products is 17 04 05.

2.17 Further information
For further information on these products please refer to http://www.outokumpu.com.

3. LCA: Calculation rules

3.1 Declared Unit
The declaration applies to one ton of hot rolled stainless steel product. The declared unit is the production and recycling of one ton of hot rolled stainless steel product.

3.2 System boundary
This EPD is cradle-to-gate with options, and includes the following process steps:
· Upstream production of raw materials, fuels and energy and all relevant upstream transport processes.
· Production/manufacturing of the stainless steel product.
· Waste water and treatment of wastes generated on site including swarf, dusts, scrap, slag and waste water.
· End-of-life (recycling, remelting or disposal of steel scrap).

3.3 Estimates and assumptions
95 % of hot rolled structural steel products are assumed to be recycled at end-of-life. The average hot rolled product produced by Outokumpu has a stainless steel scrap content of 59.1 % hence the net stainless steel scrap output is 35.9 % (95 % - 59.1 %). This stainless steel scrap is declared as a credit in module D. This means that for each 1000 kg of hot rolled stainless steel product produced, 359 kg stainless steel scrap is credited.

End-of-Life Scenario
At end-of-life, a 95 % recycling rate for the steel product is assumed. The remaining 5 % is assumed to remain uncollected or to go to disposal e.g. landfill.

3.4 Cut-off criteria
All data gathered from the production data acquisition are considered, i.e. all raw materials, water, thermal and electrical energy, packaging materials, and production waste. The principal material transport processes (such as alloys and scrap) are also considered. Thus, even minor material and energy flows of less than 1 % mass are included. The total sum of neglected processes per module A and D (for the sub-modules covered) does not exceed 5 %. Machines, facilities and infrastructure required during manufacture are not taken into account.

3.5 Background data
Background data for upstream materials, fuels and energy production are taken from the /**GaBi 6 Software**/ produced by PE INTERNATIONAL.

3.6 Data quality
Production has been modeled using 2011 average production data provided by Outokumpu's own sites and has been quality-checked by Outokumpu and PE INTERNATIONAL.

3.7 Period under review
Modelling is based on production data from 2011. Background data used are from the period 2010 to 2012 and are taken from the /**GaBi 6 Software** /. Documentation related to all the processes used in the stainless steel production model can be found in the GaBi 6 documentation /**GaBi 6 Documentation**/.

3.8 Allocation
Slag generated as a by-product of electric arc furnace (EAF) steelmaking is used as an input to a variety of industries including as a constituent of cement, in road building or as fill material. An allocation methodology to account for this in line with the requirements of /**EN 15804**/ is being developed by European steel industry partners, but is not available for stainless steels at the present time. In the interim, this study has adopted a conservative approach and has assumed that all the environmental burdens associated with the production of stainless steel products and EAF slag are allocated to the production of steel.

Production losses of steel during the production process are recycled in a closed loop reducing the requirement for external scrap.

Specific information on allocation within the background data is given in the GaBi datasets documentation (/**GaBi 6 Documentation/)**.

3.9 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.

4. LCA: Scenarios and additional technical information

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

Name	Value	Unit
Stainless steel scrap input (into module A)	59.1	%
End-of-life recycling rate	95	%
Net stainless steel scrap credit	35.9	%
Equiv. Mass of stainless steel scrap credited per ton product	359	kg

5. LCA: Results

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

PRODUCT STAGE			CONSTRUCTION PROCESS STAGE		USE STAGE							END OF LIFE STAGE				BENEFITS AND LOADS BEYOND THE SYSTEM BOUNDARYS
Raw material supply	Transport	Manufacturing	Transport from the gate to the site	Assembly	Use	Maintenance	Repair	Replacement[1)]	Refurbishment[1)]	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	MND	MND	MND	MND	MND	MND	MND	MND	MND	X

RESULTS OF THE LCA - ENVIRONMENTAL IMPACT: declared unit and product

Parameter	Unit	A1 - A3	D
Global warming potential	[kg CO_2-Eq.]	2750	-2150
Depletion potential of the stratospheric ozone layer	[kg CFC11-Eq.]	-1.07E-5	-1.16E-5
Acidification potential of land and water	[kg SO_2-Eq.]	22.2	-19.7
Eutrophication potential	[kg $(PO_4)^{3-}$- Eq.]	0.99	-1.25
Formation potential of tropospheric ozone photochemical oxidants	[kg Ethen Eq.]	1.85	-1.24
Abiotic depletion potential for non fossil resources	[kg Sb Eq.]	0.298	-0.158
Abiotic depletion potential for fossil resources	[MJ]	35200	-27100

RESULTS OF THE LCA - RESOURCE USE: declared unit and product

Parameter	Unit	A1 - A3	D
Renewable primary energy as energy carrier	[MJ]	5680	-1060
Renewable primary energy resources as material utilization	[MJ]	0	0
Total use of renewable primary energy resources	[MJ]	5680	-1060
Non renewable primary energy as energy carrier	[MJ]	35400	-27200
Non renewable primary energy as material utilization	[MJ]	0	0
Total use of non renewable primary energy resources	[MJ]	35400	-27200
Use of secondary material	[kg]	818	0
Use of renewable secondary fuels	[MJ]	0	0
Use of non renewable secondary fuels	[MJ]	0	0
Use of net fresh water	[m^3]	-	-

RESULTS OF THE LCA – OUTPUT FLOWS AND WASTE CATEGORIES: declared unit and product

Parameter	Unit	A1 - A3	D
Hazardous waste disposed	[kg]	-	-
Non hazardous waste disposed	[kg]	-	-
Radioactive waste disposed	[kg]	2.61	-0.142
Components for re-use	[kg]	-	-
Materials for recycling	[kg]	204	-
Materials for energy recovery	[kg]	-	-
Exported electrical energy	[MJ]	0	0
Exported thermal energy	[MJ]	0	0

6. LCA: Interpretation

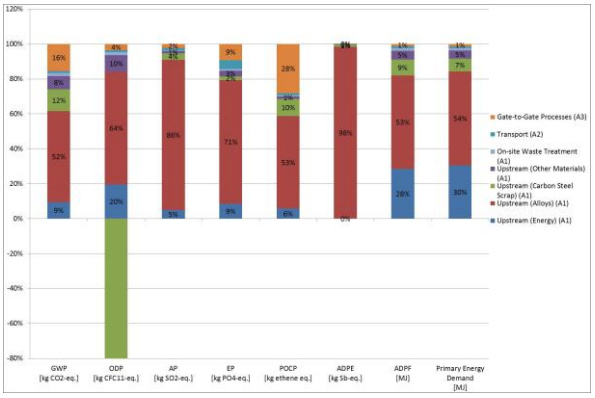


Figure 1: Environmental impact shares of production stages and major input materials

Figure 1 illustrates the percentage contribution of major raw materials and production stages to the overall cradle-to-gate environmental impact of 1t of hot rolled stainless steel. With the exception of ozone depletion potential, the production of upstream alloys was the dominant source of environmental impacts across all the environmental impact categories as well as primary energy demand. Upstream alloys contribute more than 50 % of the impacts associated with all these categories. The most significant alloying contributions come from the production of ferronickel, ferrosilicon and ferrochrome.

For global warming potential (GWP), upstream alloys contribute 52 % with on-site emissions, the burden of carbon steel scrap and the production of electricity and other fuels collectively contributing an additional 37 %.

Acidification potential (AP), eutrophication potential (EP) and abiotic depletion of elements (ADPE) are all strongly dominated by alloy production with no other processes contributing more than 10 %. ADPE is the most extreme example with alloy production being responsible for 98 % of the cradle-to-gate impact. The formation potential of tropospheric ozone photochemical oxidants (POCP) impact category has a significant 28 % contribution from on-site emissions due to carbon monoxide emissions during processing. As both abiotic depletion potential of fossil resources (ADPF) and primary energy demand are measures of fuel resource/energy consumption the production of energy resources used on site is a significant impact (28 % and 30 % respectively).

Ozone depletion potential (ODP) is shown as gaining a large credit from the consumption of carbon steel scrap (the overall A1-A3 impact is negative for ODP). The burden of carbon steel scrap is calculated as the LCI of a 100 % primary production route (Blast furnace/Basic Oxygen Furnace) minus the LCI of a 100 % secondary production route (Electric Arc Furnace). The ODP of EAF steel is generally higher than that of BF/BOF steel due to higher electricity consumption, resulting in the "credit" seen in figure 1.

The EPD is based on 2011 production. Variance in the LCIA results between sites was primarily driven by differences in grid mix and the mix of stainless scrap vs carbon steel scrap/ferroalloys. As all sites were served by the same ferrochrome mine and had extremely similar profiles for other alloys (e.g. nickel/ferronickel, ferromolybdenum), there was almost no variation between the impacts per tonne for these input materials.

7. Requisite evidence

This EPD covers hot rolled products which are likely to be employed in a variety of applications including structures such as heavy transport, bridges and floodgates, building fixings, traffic barriers, and façade components, many of which will require further processing and fabrication related to the final application. Consequently, further documentation is not applicable.

7.1 Weathering performance

Where hot rolled stainless steel is used in an external application, no corrosion shall occur as stainless steel is inherently non-corrosive. For this reason, stainless steel products are often applied where corrosion resistance is a key performance characteristic.

8. References

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ISO 14025
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EN 15804
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PCR Part B
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EN 10088-1
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EN 10028-7
EN 10028-7:2007: Flat products made of steels for pressure purposes - Stainless steels

ASTM A240
ASTM A240: Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications

ASME II-D
ASME II-D: 2013: BPVC Section II Materials Part D - Properties

JIS G4304
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ISO 9001
ISO 9001:2008: Quality management systems - Requirements

ISO 14001
ISO 14001:2004: Environmental management

OHSAS 18001
BS OHSAS 18001:2007: Occupational health and safety management systems – Requirements

EC3
EN 1993 – Eurocode 3: Design of steel structures

EC4
EN1994 – Eurocode 4: Design of composite steel and concrete structures

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GaBi 6 Documentation
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Publisher
Institut Bauen und Umwelt e.V.
Panoramastr. 1
10178 Berlin
Germany

Tel +49 (0)30 3087748- 0
Fax +49 (0)30 3087748- 29
Mail info@bau-umwelt.com
Web **www.bau-umwelt.com**

Programme holder
Institut Bauen und Umwelt e.V.
Panoramastr 1
10178 Berlin
Germany

Tel +49 (0)30 - 3087748- 0
Fax +49 (0)30 – 3087748 - 29
Mail info@bau-umwelt.com
Web **www.bau-umwelt.com**

Author of the Life Cycle Assessment
PE INTERNATIONAL AG
Hauptstrasse 111
70771 Leinfelden-Echterdingen
Germany

Tel +49 (0) 711 34 18 17
Fax +49 (0) 711 34 18 17
Mail info@pe-interntional.com
Web **www.pe-international.com**

Owner of the Declaration
Outokumpu
Riihitontuntie 7
02201 Espoo
Finland

Tel +358 (0) 9 4211
Fax +358 (0) 9 421 5555
Mail info.stainless@outokumpu.com
Web **www.outokumpu.com**