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-20190107-IBD1-EN
Issue date	19/09/2019
Valid to	18/09/2024

Stainless Steel Long Product

Outokumpu Oyj

Institut Bauen und Umwelt e.V.

www.ibu-epd.com / https://epd-online.com

1. General Information

Outokumpu	Stainless Steel Long Product
Programme holder IBU - Institut Bauen und Umwelt e.V. Panoramastr. 1 10178 Berlin Germany	**Owner of the declaration** Outokumpu Oyj Salmisaarenranta 11 FI-00181 Helsinki Finland
Declaration number EPD-OTO-20190107-IBD1-EN	**Declared product / declared unit** This EPD applies to 1 ton of stainless steel long 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, 07.2014 (PCR checked and approved by the SVR)	**Scope:** The declaration applies to 1 ton of stainless steel long product produced by Outokumpu. The Life Cycle Assessment is based on data from the following Outokumpu production plants: - Outokumpu Stainless Ltd, Sheffield, UK - Outokumpu Stainless USA LLC, Richburg, SC, USA - Fagersta Stainless AB, Fagersta, Sweden Production has been modeled using annual production data from 2017 and 2018. 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 19/09/2019	
Valid to 18/09/2024	**Verification** The standard /EN 15804/ serves as the core PCR Independent verification of the declaration and data according to /ISO 14025:2010/ ☐ internally ☒ externally
Dipl. Ing. Hans Peters (President of Institut Bauen und Umwelt e.V.)	
Dr. Alexander Röder (Managing Director IBU)	Angela Schindler (Independent verifier appointed by SVR)

2. Product

2.1 Product description / Product definition

This EPD describes stainless steel long products produced by Outokumpu. Long products are supplied as black, peeled or cold drawn bar or as rod coil. The computerised process control of our rolling mills, heat treatment facilities, and finishing lines ensures consistency and superior control of the targeted properties. Stainless steel long products are available in a wide range of sizes in both standard and special grades. This EPD is applicable to homogeneous Outokumpu stainless steel long products which are used in the construction and building industry. The data have been provided by a representative mix of four manufacturing plants in the UK, USA and Sweden.

For the placing on the market of the product in the EU/EFTA (with the exception of Switzerland) Regulation (EU) No. 305/2011 (CPR) applies.
The product needs a declaration of performance taking into consideration /EN 10088-5:2009/: Stainless steels. Technical delivery conditions for bars, rods, wire, sections and bright products of corrosion resisting steels for construction purposes.
For the application and use the respective national provisions apply.

2.2 Application

Long products are used in a wide range of applications in building and construction. Typical applications are fixings, wall ties, couplings, and dowel bars.

2.3 Technical Data

Constructional data

Name	Value	Unit
Density	7900	kg/m^3
Modulus of elasticity	205000	N/mm^2
Coefficient of thermal expansion	14	$10^{-6}K^{-1}$
Thermal conductivity	19	W/(mK)
Melting point	1450	°C
Proof Strength Rp 0.2	175-1000	MPa
Tensile Strength Rm	450-950	MPa
Elongation A	10-45	%

Performance data of the product in accordance with the declaration of performance with respect to its essential characteristics according to /EN 10088-5:2009/: Stainless steel. Technical delivery conditions for bars, rods, wire, sections and bright products of corrosion resisting steels for construction purposes. /EN 10272/, /ASTM A276/, /ASME IID/, /JIS G4303/ (not part of CE marking).

2.4 Delivery status

The products are produced in accordance with various national and/or international technical regulations. The products are certified in accordance with product standards:
/EN 10088-5/
/EN 10272/
/ASTM A276/
/ASME IID/
/JIS G4303/

More detailed information on technical properties in the Outokumpu brochure “Steel Grades, Properties and Global Standards”. The dimensions of the declared product may vary according to the final use

2.5 Base materials / Ancillary materials

Stainless steels are iron alloys that contain more than 10.5% chromium and less than 1.2% carbon. Composition below is given in weight percentages

Chromium: 10.5% to 30%
Nickel: max. 38%
Molybdenum: max. 11%
Carbon: max. 1.2%
Iron: balance (>50%)

Manufacturing is based on recycling and ferrous scrap, (predominantly stainless steel scrap) is used as raw material. Alloying elements are also added as ferroalloys or metals. Other elements such as Manganese (Mn), Nitrogen (N), Niobium (Nb), Titanium (Ti), Copper (Cu) and Silicon (Si) may be present. The presence and rates of these alloying elements depend on the stainless steel designation as set out in /EN 10088-1/.
This product contains substances listed in the candidate list (date: 05.08.2019) exceeding 0.1 percentage by mass: no
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
Biocide products were added to this construction product or it has been treated with biocide products: no

2.6 Manufacture

The steel scrap is melted in an electric arc furnace to obtain a steel melt. The liquid steel is further refined (adjustment of sulfur, carbon and phosphorous) and alloyed to give the stainless steel the required characteristics. The steel is then cast into semi-finished stainless steel products, for example billets. The billets are hot rolled to the desired bar size or the billets are hot rolled to rod coil and then annealed and pickled. The bar can also be peeled and the rod coil cold drawn and cut to bar.
Quality management are in accordance with /ISO 9001/.

2.7 Environment and health during manufacturing

Environmental, occupational health and safety management are in accordance with /**ISO 14001**/ and /**OHSAS 18001**/.

2.8 Product processing/Installation

Processing of the rod coil or bar lengths has to be carried out depending on the respective application according to the generally recognised rules of engineering and the manufacturer’s recommendation. Eurocode 3 and 4 **/EC3/** and **/EC4/** apply to the design of construction. EC3 and EC4 include requirements regarding performance, durability and fire resistance of steel and composite structures.

During handling and the use of the products, normal occupational safety measures should be applied. Any 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 on water, air or soil.
Residual material, for example steel scrap, should be collected as it is 100% recyclable.

2.9 Packaging

Stainless steel long products are supplied in rod coil form or bar lengths using a combination of the following packaging systems:

- Plastic straps
- Galvanised strapping and plastic sleeves
- Lamiflex
- Plasticised paper
- Wooden boxes
- Polyweave
- Plastic straps and pallets.

2.10 Condition of use

The maintenance requirements depend on the specific design and application, but typically stainless steel only requires a minimum or no maintenance.

2.11 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 (VOC) to indoor air.
Similarly, no significant environmental impact on water, air or soil is expected, due to the extremely low metal release from stainless steel and the low maintenance need.

2.12 Reference service life

Service life is dependent upon corrosion environment, physical and mechanical service conditions. Correct alloy designation choice can satisfy a required service life.

2.13 Extraordinary effects

Fire

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

Fire protection

Name	Value
Building material class	A1

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.

2.14 Re-use phase

Stainless steel 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 usually recycled and can be recycled to the same quality of steel without loss of properties.

2.15 Disposal

Stainless steel scrap is a valuable resource with well-established recycling routes. Disposal is not recommended, but no adverse environmental impact is known.

The /**European Waste Catalogue**/ code for iron and steel products is 17 04 05.

2.16 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 stainless steel long product. The declared unit is the production and recycling of one ton of stainless steel long product.

Declared unit

Name	Value	Unit
Declared unit	1000	kg

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 and packaging 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

Primary data was used to model all on-site processes. This data was cross-checked to identify and eliminate data gaps. High quality secondary data from the GaBi database was used to model upstream material and energy flows. Secondary data was as technologically and geographically representative as possible. However, for some of minor auxiliary materials such as limestone, grease, lubricant similar or best estimated datasets are used to make sure that the data was still considered to be technologically representative for European production.

Due to lack of available dataset for some alloying elements e.g. Ferro-Vanadium South-African data sets were used instead of local data. It's considered as conservative choice.

Sorting and Shredding data from Ecoinvent Database is chosen to model the module C3.

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 reported data were incorporated and modelled i.e. all raw materials, water, thermal and electrical energy, 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.

Data for the sites were cross-checked with one another to identify potential data gaps. No processes, materials or emissions that are known to make a significant contribution to the environmental impact of the products studied, have been omitted.

It can be assumed, that all excluded flows contribute less than 5% to the impact assessment categories.

These packaging materials and its transportation were considered in data collection and in LCA model but doesn't have noticeable effects on the results.

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 Database SP36**/.

3.6 Data quality
Production has been modeled using 2017 average production data provided by Outokumpu's own sites and has been quality-checked by Outokumpu and thinkstep.

3.7 Period under review
Modelling is based on production data from 2017. Background data used are from the 2018 version of /**GaBi Database SP36**/. Documentation related to all the processes used in the stainless steel production model can be found in the GaBi documentation /**GaBi 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.
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, with slag included under the material for recycling (MFR) category.

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 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.

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4. LCA: Scenarios and additional technical information

For this steel product following the average end of life scenarios were considered with the corresponding benefits and burdens:
Landfilling of 5 %, a recycling rate of 95 %.
The stainless steel scrap input into Modul A is 760,4 kg; this results in a value of scrap benefit of 189,6 kg.

End of life (C3)

Name	Value	Unit
Sorting&Shredding	100	%

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

Name	Value	Unit
End-of-life recycling rate	95	%
Stainless steel scrap input (into module A)	76	%
Net stainless steel scrap credit	19	%
Equiv. Mass of stainless steel scrap credited per ton product	189,6	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 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	MND	MND	X	MND	X

RESULTS OF THE LCA - ENVIRONMENTAL IMPACT: 1 t Stainless Steel Long Product

Parameter	Unit	A1-A3	C3	D
Global warming potential	[kg CO_2-Eq.]	2.89E+3	2.48E+0	-9.53E+2
Depletion potential of the stratospheric ozone layer	[kg CFC11-Eq.]	4.16E-9	7.00E-12	-7.35E-13
Acidification potential of land and water	[kg SO_2-Eq.]	2.09E+1	9.61E-3	-6.01E+0
Eutrophication potential	[kg $(PO_4)^{3-}$-Eq.]	1.09E+0	1.19E-3	-3.32E-1
Formation potential of tropospheric ozone photochemical oxidants	[kg ethene-Eq.]	9.50E-1	6.99E-4	-3.59E-1
Abiotic depletion potential for non-fossil resources	[kg Sb-Eq.]	1.97E-1	1.14E-6	-5.24E-2
Abiotic depletion potential for fossil resources	[MJ]	3.16E+4	2.87E+1	-1.14E+4

RESULTS OF THE LCA - RESOURCE USE: 1 t Stainless Steel Long Product

Parameter	Unit	A1-A3	C3	D
Renewable primary energy as energy carrier	[MJ]	7.33E+3	1.20E+1	-1.83E+3
Renewable primary energy resources as material utilization	[MJ]	0.00E+0	0.00E+0	0.00E+0
Total use of renewable primary energy resources	[MJ]	7.33E+3	1.20E+1	-1.83E+3
Non-renewable primary energy as energy carrier	[MJ]	3.72E+4	4.07E+1	-1.16E+4
Non-renewable primary energy as material utilization	[MJ]	0.00E+0	0.00E+0	0.00E+0
Total use of non-renewable primary energy resources	[MJ]	3.72E+4	4.07E+1	-1.16E+4
Use of secondary material	[kg]	7.60E+2	0.00E+0	0.00E+0
Use of renewable secondary fuels	[MJ]	0.00E+0	0.00E+0	0.00E+0
Use of non-renewable secondary fuels	[MJ]	0.00E+0	0.00E+0	0.00E+0
Use of net fresh water	[m^3]	3.23E+1	1.65E-2	-1.34E+1

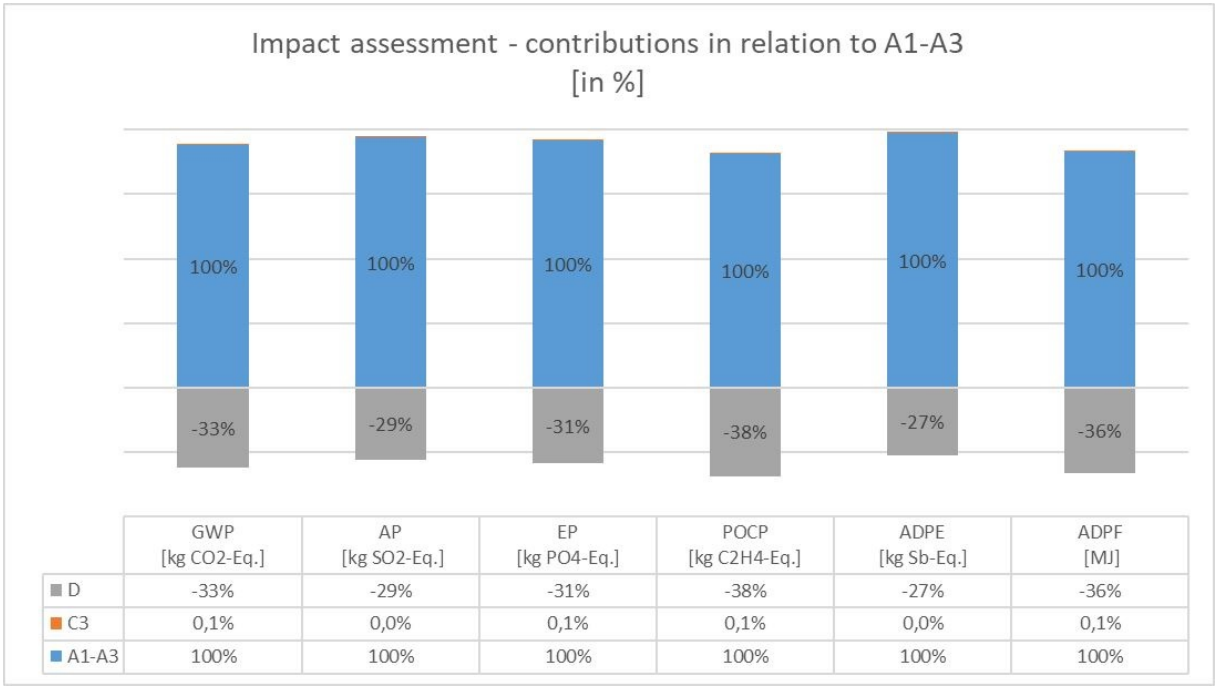
RESULTS OF THE LCA – OUTPUT FLOWS AND WASTE CATEGORIES: 1 t Stainless Steel Long Product

Parameter	Unit	A1-A3	C3	D
Hazardous waste disposed	[kg]	3.30E-2	3.28E-7	-1.20E-1
Non-hazardous waste disposed	[kg]	2.16E+2	5.01E+1	1.27E+1
Radioactive waste disposed	[kg]	2.30E+0	4.80E-3	-9.82E-2
Components for re-use	[kg]	0.00E+0	0.00E+0	0.00E+0
Materials for recycling	[kg]	0.00E+0	9.50E+2	0.00E+0
Materials for energy recovery	[kg]	0.00E+0	0.00E+0	0.00E+0
Exported electrical energy	[MJ]	0.00E+0	0.00E+0	0.00E+0
Exported thermal energy	[MJ]	0.00E+0	0.00E+0	0.00E+0

*NOTE: The results above represent an average of multiple production routes & sites as well as multiple stainless steel grades for Long product – produced at Outokumpu. In case of specific product with precise information on manufacturing site and/or grade of steel, an individual request to Outokumpu is required.

6. LCA: Interpretation

This chapter contains an interpretation of the Life Cycle Impact Assessment categories with regards to the functional unit – 1 ton of stainless steel product. It focuses on the dominant contributions during the production process and recycling steel at its end of life.



	GWP [kg CO2-Eq.]	AP [kg SO2-Eq.]	EP [kg PO4-Eq.]	POCP [kg C2H4-Eq.]	ADPE [kg Sb-Eq.]	ADPF [MJ]
D	-33%	-29%	-31%	-38%	-27%	-36%
C3	0,1%	0,0%	0,1%	0,1%	0,0%	0,1%
A1-A3	100%	100%	100%	100%	100%	100%

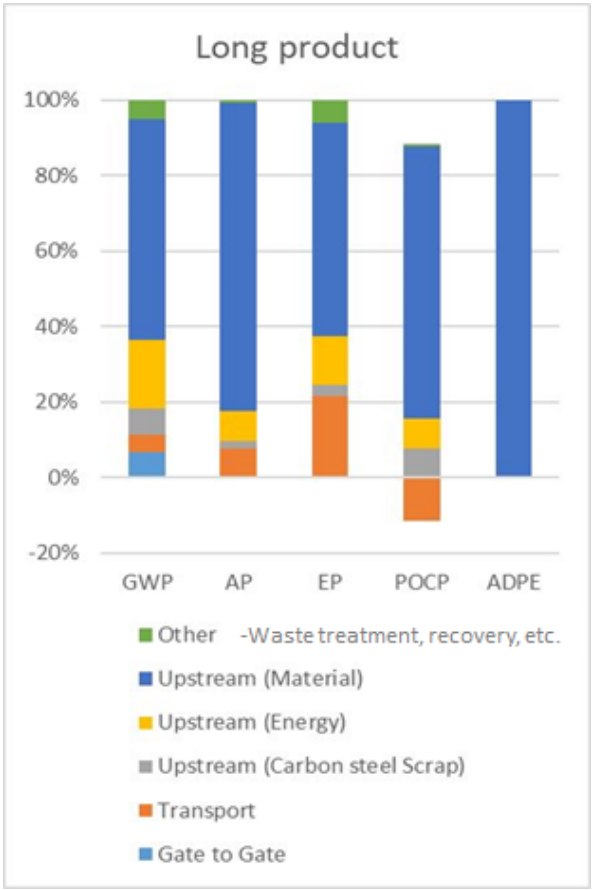
The figure above shows the relative contribution of the production stages (Module A1-A3), waste treatment (Module C3) and the benefits and loads beyond the product system boundary (Module D).
For all categories, the results for the product stage (A1-3) contributes with the highest shares. Overall, C3 has a minimized contribution. The credits in Module D have a considerable share, thanks to the recycling.

The most relevant emissions on stainless steel production:
for **Global Warming Potential (GWP**) are CO2, CH4
for **Acidification Potential** (**AP)** are SO2 and NOx;
for **Eutrophication Potential (EP**) are NOx
for **Photochemical Ozone Creation Potential (POCP)** are CO, SO2, NOx, and NMVOC.

The main contribution to A1-A3 is the production of upstream materials, which is dominated by the production of the Fe-alloys Fe-Cr, Fe-Ni, Fe-Si, and Fe-Mo. The production of the listed Fe-alloys is high in energy consumption on Primary Energy Demand and registers high emissions of carbon dioxide, nitrogen oxides, and sulfur dioxide with the resulting effect on Global Warming Potential, Acidification Potential, Eutrophication Potential and Photochemical Ozone Creation Potential.

In addition to the upstream material production, a certain influence on the overall results is given by the upstream energy production related to the electricity and fuel consumption on-site. Depending on the location of the site this influence might vary related to the
country-specific energy supply.

The following figure summarizes percentage contributions to selected impact category for each of the products (cradle-to-gate), showing the large contribution from upstream materials.



7. Requisite evidence

This EPD covers stainless steel long products which are likely to be employed in a variety of applications including building envelopes, interior cladding and paneling, heating, cooling and ventilation, lifts and elevators, many of which will require further processing and fabrication related to the final application. Consequently, further documentation is not applicable.

7.1 Weathering performance

The majority of the applications described in section 2.2 relate to the interior of buildings. However, where the stainless steel long product 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 such as marine environments.

8. References

/IBU 2016/
IBU (2016): General Programme Instructions for the Preparation of EPDs at the Institut Bauen und Umwelt e.V., Version 1.1 Institut Bauen und Umwelt e.V., Berlin.
www.ibu-epd.de

/ISO 14025/
DIN EN /ISO 14025:2011-10/, Environmental labels and declarations — Type III environmental declarations — Principles and procedures

/EN 15804/
/EN 15804:2012-04+A1 2013/, Sustainability of construction works — Environmental Product Declarations — Core rules for the product category of construction products

/PCR Part A/
Product Category Rules for Building-Related Products and Services, Calculation Rules for the Life Cycle Assessment and Requirements on the Project Report. Version 1.8, 07.2019. Institut Bauen und Umwelt e.V. (IBU) www.bau-umwelt.de

/PCR Part B/
Institut Bauen und Umwelt e.V., Berlin (pub.): PCR Guidance Texts for Building Related Products and Services, Part B: Requirements on the EPD for Structural Steels. 2017

/CPR/
Regulation (EU) No 305/2011 of the European Parliament and of the Council of 9 March 2011 laying down harmonised conditions for the marketing of construction products

/EN 10088-1/
EN 10088-1:2014: Stainless Steels. List of stainless steels

/EN 10088-5/
EN 10088-5:2009: Stainless steels. Technical delivery conditions for bars, rods, wire, sections and bright products of corrosion resisting steels for construction purposes.

/EN 10272/
EN 10272:2007: Stainless steel bars for pressure purposes

/ASTM A276/
ASTM A276: Standard specification for stainless steel plate bars and shapes

/ASME II-D/
ASME II-D: 2017: BPVC Section II Materials Part D - Properties

/JIS G4303/
JIS G4303:2012: Stainless steel bars

/SVHC/
Candidate List of substances of very high concern for Authorisation in accordance with Article 59(10) of the REACH Regulation (EC) No 1907/2006 as of 30 June 2019

/ISO 9001/
ISO 9001:2015: Quality management systems - Requirements

/ISO 14001/
ISO 14001:2015: 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

/EN 13501-1/
EN 13501-1: 2007: Fire classification of construction products and building elements-Part1

/European Waste Catalogue/
2000/532/EC - European Waste Catalogue. Commission Decision of 3 May 2000.

/GaBi Database SP36/
GaBi Software and Databasis for Life Cycle Engineering. IABP, University of Stuttgart und thinkstep AG, 2018.

/GaBi Documentation/
GaBi ts Documentation GaBi ts: Documentation of the GaBi datasets for Life Cycle Engineering. IABP,

University of Stuttgart und thinkstep AG, 2018. http://www.gabi-software.com/international/support/gabi/

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