

# ENVIRONMENTAL PRODUCT DECLARATION

as per /ISO 14025/ and /EN 15804/




Owner of the Declaration	<b>Outokumpu Oyj</b>
Programme holder	Institut Bauen und Umwelt e.V. (IBU)
Publisher	Institut Bauen und Umwelt e.V. (IBU)
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Valid to	27/06/2024

## Hot Rolled Stainless Steel Outokumpu Oyj

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## 1. General Information

<p><b>Outokumpu Oyj</b></p> <hr/> <p><b>Programme holder</b>          IBU - Institut Bauen und Umwelt e.V.          Panoramastr. 1          10178 Berlin          Germany</p> <hr/> <p><b>Declaration number</b>          EPD-OTO-20190003-IBD1-EN</p> <hr/> <p><b>This declaration is based on the product category rules:</b>          Structural steels, 07.2014          (PCR checked and approved by the SVR)</p> <hr/> <p><b>Issue date</b>          28/06/2019</p> <hr/> <p><b>Valid to</b>          27/06/2024</p>	<p><b>Hot Rolled Stainless Steel</b></p> <hr/> <p><b>Owner of the declaration</b>          Outokumpu Oyj          Salmisaarenranta 11          FI-00181 Helsinki          Finland</p> <hr/> <p><b>Declared product / declared unit</b>          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.</p> <hr/> <p><b>Scope:</b>          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, Torshälla, Sweden          - Outokumpu Stainless Oy, Tornio, Finland          - Outokumpu Nirosta GmbH, Dillenburg, Germany          - Outokumpu Nirosta GmbH, Krefeld, Germany          - Outokumpu Stainless USA LLC, Calvert, AL, USA</p> <p>Production has been modeled using annual production data from 2017. Where required averaging is based on production output from each site.</p> <p>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.</p> <hr/> <p><b>Verification</b></p> <table border="1"> <tr> <td colspan="2">The standard /EN 15804/ serves as the core PCR</td> </tr> <tr> <td colspan="2">Independent verification of the declaration and data according to /ISO 14025:2010/</td> </tr> <tr> <td><input type="checkbox"/> internally</td> <td><input checked="" type="checkbox"/> externally</td> </tr> </table>	The standard /EN 15804/ serves as the core PCR		Independent verification of the declaration and data according to /ISO 14025:2010/		<input type="checkbox"/> internally	<input checked="" type="checkbox"/> externally
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<p></p> <hr/> <p>Prof. Dr.-Ing. Horst J. Bossenmayer          (President of Institut Bauen und Umwelt e.V.)</p>	<p></p> <hr/> <p>Dr.-Ing. Andreas Ciroth          (Independent verifier appointed by SVR)</p>						
<p></p> <hr/> <p>Dr. Alexander Röder          (Head of Board IBU)</p>							

## 2. Product

### 2.1 Product description / Product definition

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.

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 10088-4:2009/, Stainless steels. Technical delivery conditions for sheet/plate and strip of corrosion resisting steels for construction purposes/, /Limiting dimension and shape tolerance: Tolerances according to ISO (EN) 9444-2/ 9445-2/, /EN 10029/ and the CE-marking. For the application and use the respective national provisions apply.

### 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 <sup>3</sup>
Coefficient of thermal expansion	14	10 <sup>-6</sup> K <sup>-1</sup>
Thermal conductivity	19	W/(mK)
Modulus of elasticity	205	GPa
Melting point	1450	°C
Proof strength Rp0.2	200-530	MPa
Tensile strength Rm	450-950	MPa
Elongation A	18-45	%
Impact strength KV	40-90 (transverse )	J
Weldability	covered by chemical composition	
Durability	covered by chemical composition	
Fracture toughness	covered by impact strength	
Cold formability	covered by elongation	

performance data of the product in accordance with the declaration of performance with respect to its essential characteristics according to /EN 10088-1:2014/, /EN 10028-7:2016/, /ASTM A240/, /ASME IID 2017/, /EN 10204:2005/, (not part of CE-marking).

### 2.4 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.

The products are certified in accordance with product standards :

**/EN 10088-1/  
/EN 10028-7/  
/ASTM A240/  
/ASME IID/  
/EN 10204/**

### 2.5 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 stainless steel in declarable quantities.

### 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 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.

### 2.7 Environment and health during manufacturing

Environmental, occupational health and safety and quality management are in accordance with /ISO 14001/, /ISO 9001/ and /OHSAS 18001/

### 2.8 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 no significant environmental impact to water, air or soil is known.

Residual material like steel scrap should be collected as it is 100% recyclable.

### 2.9 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.

### 2.10 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.

### 2.11 Environment and health during use

Under normal conditions of use, no adverse health effects are known for stainless steel products.

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.

### 2.12 Reference service life

Service life is dependent upon 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/).

#### 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 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 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 hot rolled stainless steel product. The declared unit is the production and recycling of one ton of hot rolled stainless steel 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 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 71.35 % hence the net stainless steel scrap output is 23.65 % (95 % -71.35 %). 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, 236.5 kg stainless steel scrap is credited.

The carbon steel scrap used as input is not included in these numbers as carbon steel scrap is considered an open loop with own burden.

#### 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 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. Packaging materials and its transportation are neglected due to low contribution to the overall life cycle 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/.

### 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/. 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.

context, respectively the product-specific characteristics of performance, are taken into account.

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

## 4. LCA: Scenarios and additional technical information

For this steel product following 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 713,5 kg; this results in a value of scrap benefit of 236,5 kg.

#### End of life (C3)

Name	Value	Unit
Landfilling	5	%

#### 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)	71.35	%
Net stainless steel scrap credit	23.65	%
Equiv. Mass of stainless steel scrap credited per ton product	236.5	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 Hot Rolled Stainless Steel product

Parameter	Unit	A1-A3	C3	D
Global warming potential	[kg CO <sub>2</sub> -Eq.]	2.74E+3	2.48E+0	-1.19E+3
Depletion potential of the stratospheric ozone layer	[kg CFC11-Eq.]	4.29E-9	7.00E-12	-9.17E-13
Acidification potential of land and water	[kg SO <sub>2</sub> -Eq.]	1.45E+1	9.61E-3	-7.50E+0
Eutrophication potential	[kg (PO <sub>4</sub> ) <sup>3</sup> -Eq.]	9.78E-1	1.19E-3	-4.14E-1
Formation potential of tropospheric ozone photochemical oxidants	[kg ethene-Eq.]	8.89E-1	6.99E-4	-4.48E-1
Abiotic depletion potential for non-fossil resources	[kg Sb-Eq.]	1.86E-1	1.14E-6	-6.54E-2
Abiotic depletion potential for fossil resources	[MJ]	3.24E+4	2.87E+1	-1.43E+4

### RESULTS OF THE LCA - RESOURCE USE: 1 t Hot Rolled Stainless Steel product

Parameter	Unit	A1-A3	C3	D
Renewable primary energy as energy carrier	[MJ]	7.67E+3	1.20E+1	-2.28E+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]	7.67E+3	1.20E+1	-2.28E+3
Non-renewable primary energy as energy carrier	[MJ]	3.72E+4	4.07E+1	-1.45E+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	-1.45E+4
Use of secondary material	[kg]	7.14E+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 <sup>3</sup> ]	3.40E+1	1.65E-2	-1.67E+1

### RESULTS OF THE LCA – OUTPUT FLOWS AND WASTE CATEGORIES: 1 t Hot Rolled Stainless Steel product

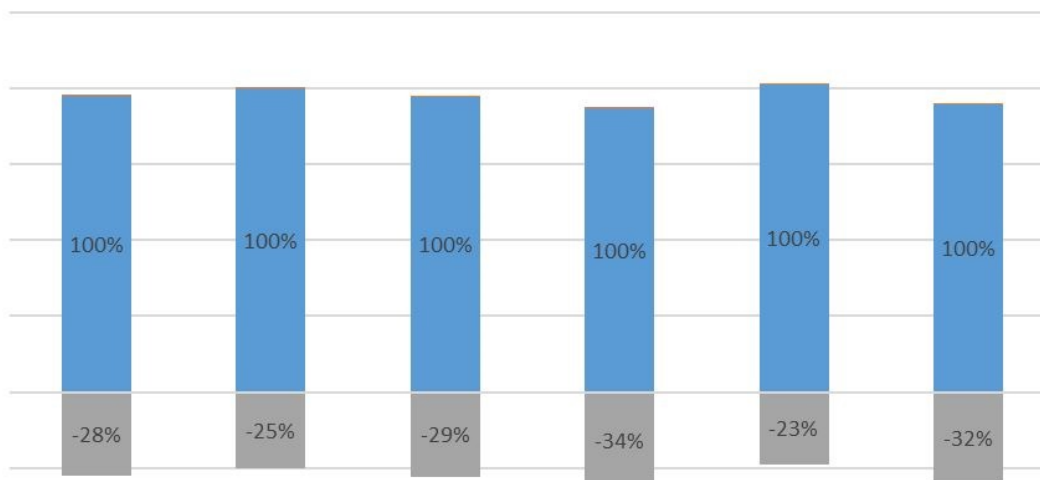
Parameter	Unit	A1-A3	C3	D
Hazardous waste disposed	[kg]	4.61E-2	3.28E-7	-1.50E-1
Non-hazardous waste disposed	[kg]	3.20E+2	5.01E+1	1.58E+1
Radioactive waste disposed	[kg]	1.95E+0	4.80E-3	-1.23E-1
Components for re-use	[kg]	0.00E+0	0.00E+0	0.00E+0
Materials for recycling	[kg]	0.00E+0	9.50E+2	0.00E+0
Materials 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

## 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.

Cold rolled steel: Impact assessment - contributions in relation to A1-A3 [in %]



	GWP [kg CO2-Eq.]	AP [kg SO2-Eq.]	EP [kg PO4-Eq.]	POCP [kg C2H4-Eq.]	ADPE [kg Sb-Eq.]	ADPF [MJ]
■ D	-28%	-25%	-29%	-34%	-23%	-32%
■ C3	0,1%	0,0%	0,1%	0,1%	0,0%	0,1%
■ A1-A3	100%	100%	100%	100%	100%	100%

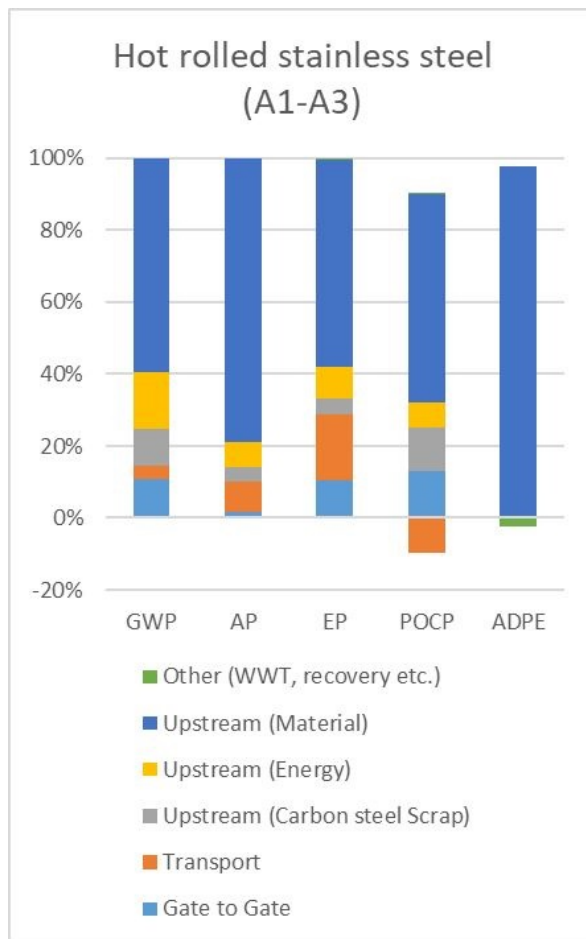
The figure above shows the relative contribution of the production stages (Module A1-A3), waste treatment (Module C3) and the benefits and loads beyond the product system boundary (Module D). For all categories, the results for product stage (A1-3) contributes with the highest shares. Overall, C3 has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

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

The most relevant emissions on stainless steel production:  
 for **Global Warming Potential (GWP)** are CO<sub>2</sub>, CH<sub>4</sub>  
 for **Acidification Potential (AP)** are SO<sub>2</sub> and NO<sub>x</sub>;  
 for **Eutrophication Potential (EP)** are NO<sub>x</sub>  
 for **Photochemical Ozone Creation Potential (POCP)** are CO, SO<sub>2</sub>, NO<sub>x</sub>, 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 sulphur 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.



## 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

### /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](http://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 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

### /EN 10088-1/

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

**/EN 10088-4:2009/**, Stainless steels. Technical delivery conditions for sheet/plate and strip of corrosion resisting steels for construction purposes

### /EN 10028-7/

EN 10028-7:2016: 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: 2017: BPVC Section II Materials Part D - Properties

**/EN 10204/**

EN 10204:2005: Metallic materials. Types of inspection documents

**/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/**

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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