Environmental Product Declaration

According to ISO 14025

Fabricated Steel Reinforcing Bar (Rebar)

SHERWOOD STEEL LTD.

Issue Date: August 7, 2017

Valid Until: August 7, 2022

Declaration Number: 064

Declaration Information

Declaration

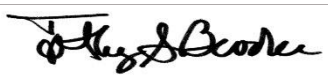
Program Operator: ASTM International	www.astm.org	sherwoodsteel.com
Company: Sherwood Steel Ltd.		

Product Information	Validity / Applicability
Product Name: Fabricated steel reinforcing bar	**Period of Validity:** This declaration is valid for a period of 5 years from the date of publication
Product Definition: Reinforcing bar or "rebar" is used to strengthen concrete or other masonry structures	
Declaration Type: Business to business	**Geographic Scope:** This declaration is valid for products sold in North America
PCR Reference: North American Product Category Rule for Designated Steel Construction Products	

Product Application and / or Characteristics

This declaration covers fabricated steel reinforcing bar ("rebar") for use in concrete and masonry structures.

Technical Drawing or Product Visual	Content of the Declaration
	• Product definition and physical building-related data Details of raw materials and material origin • Description of how the product is manufactured • Data on usage condition, unusual effects and end-of-life phase • Life Cycle Assessment results

Product Information	Validity / Applicability
This declaration and the rules on which this EPD is based have been examined by an independent verifier in accordance with ISO 14025.	
	
Name: Timothy S Brooke **Date: August 7, 2017**	**Name: Thomas P. Gloria** **Date: August 7, 2017**

EPD Summary

This document is a Type III environmental product declaration by Sherwood Steel Ltd. that is certified by ASTM International (ASTM) as conforming to the requirements of ISO 14025. ASTM has assessed that the Life Cycle Assessment (LCA) information fulfills the requirements of ISO 14040 and ISO 14044 in accordance with the instructions listed in the referenced product category rules. The intent of this document is to further the development of environmentally compatible and sustainable construction methods by providing comprehensive environmental information related to potential impacts in accordance with international standards.

Scope and Boundaries of the Life Cycle Assessment

The Life Cycle Assessment (LCA) was performed according to ISO 14040 (ISO, 2006) and ISO 14044 (ISO, 2006) following the requirements of the ASTM EPD Program Instructions and referenced PCR (SCS Global Services, 2015).

System Boundary: Cradle-to-gate
Allocation Method: Cut-off approach
Declared Unit: One metric ton (1,000 kg) of fabricated steel reinforcing bar

EVALUATION VARIABLE	UNIT PER METRIC TON	TOTAL
Primary energy non-renewable	MJ	13,200
Primary energy, renewable	MJ	868
Global warming potential	metric ton CO_2 eq.	0.964
Ozone depletion potential	metric ton CFC-11 eq.	6.53E-11
Acidification potential	metric ton SO_2 eq.	3.74E-03
Eutrophication potential	metric ton N eq.	1.94E-04
Photochemical oxidant formation potential	metric ton O_3 eq.	0.0444
Abiotic depletion potential, elements	metric ton Sb eq.	1.55E-07
Abiotic depletion potential, fossil	MJ	11,800

Additional Information

The majority of rebar is made with 98% recycled material. Sherwood Steel Ltd. sources the majority of our raw material from North America to ensure that the product that is supplied to end users is as environmentally friendly as possible.

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Product Description

Steel rebar is carbon steel used as reinforcement in concrete or masonry structures. Fabricated rebar is reinforcing steel which has been cut, bent, or modified according to job specifications set by a structural engineer.

Delivered Product Configurations

Sherwood Steel Ltd. offers rebar and welded wire mesh fabrication and installation. Our specialized knowledge and experience offer our clients the benefit of our years of experience in the industry and the peace of mind that each job with be done right and on time. Sherwood Steel began as a family business in 1972. We started as small steel fabricators and eventually grew to have two locations in Edmonton and Calgary. We have provided materials and services for a number of construction projects in every possible, sector, and we have shipped our product all over Western Canada and the Northern Territories.

Product Applicability and Technical Characteristics

Fabricated steel rebar is defined by the following standards:

- CS G30.18-09 (R2014) Stand specifications for carbon steel bars for concrete reinforcement[
- ASTM A615 Standard specification for deformed and plain carbon-steel bars for concrete reinforcement
- ASTM A706 Standard specification for deformed and plain low-alloy steel bars for concrete reinforcement

Additional information can be found on Sherwood Steel's website at www.sherwoodsteel.com.

Life Cycle Stages

The life cycle stages for fabricated rebar are summarized in the flow diagram shown in the figure below. Only the cradle-to-gate performance is considered in the analysis.

Figure 1: Life cycle modules included in analysis

Raw Materials

Fabricated rebar is manufactured entirely from steel. It does not contain any materials or substances for which there exists a route to exposure that leads to humans or flora/fauna in the environment being exposed to said materials or substances at levels exceeding safe health thresholds. Steel production at the mill was represented by a combination of data from rebar manufacturer EPDs, primary data from an upstream supplier, and datasets from thinkstep's GaBi 2017 databases (thinkstep, 2017).

Inbound Transportation

Inbound transportation distances and modes for steel were calculated based on the distances between Sherwood Steel's locations in Alberta and their rebar suppliers throughout North America.

Manufacturing

The major input to the fabrication process is the rebar itself. However, small amounts of processing materials are needed, such as lubricants for the machines. Energy is also needed to perform the process steps and move the materials. Metal scrap generated during fabrication is recycled externally.

Underlying Life Cycle Assessment

Declared Unit

The declared unit for this EPD is one metric ton of fabricated steel reinforcing bar. Note that comparison of EPD results on a mass basis, alone, is insufficient and should consider the technical performance of the product.

Declared Unit

Name	Required unit	Optional unit
Declared unit	Metric ton	Short ton
Density	7,800 kg / m^3	487 lbs. / ft^3

System Boundaries

The “cradle-to-gate” life cycle stages represent the product stage (information modules A1-A3) include:

- A1: all extraction and processing of raw materials, any reuse of products or materials from a previous product system, processing of secondary materials, and any energy recovery or other recovery processes from secondary fuels;
- A2: all transportation to the factory gate and all internal transport;
- A3: generation of fabrication electricity from primary energy resources, including upstream processes; production of all ancillary materials, pre-products, products, and co-products, including any packaging.

System Boundary (x = included inside boundary, MND = module not declared)

Product Stage			Construction Stage		Use Stage							End-of-Life Stage				Benefits & Loads
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
Raw material supply	Transport	Manufacturing	Transport	Installation	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	De-construction	Transport	Waste processing	Disposal	Reuse, recovery, recycling potential
x	x	x	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND

This EPD represents fabricated rebar production for a consecutive 12-month period in Canada over 2016 and 2017 as produced by Sherwood Steel Ltd.

Assumptions

The analysis relies on a combination of published EPDs, primary data from an upstream supplier, and data from the GaBi 2017 database to model potential impacts of upstream rebar production. Rebar fabrication data are provided by Sherwood Steel Ltd.

Cut-off Criteria

No cut-off criteria had to be applied within this study. The system boundary was defined based on relevance to the goal of the study. For the processes within the system boundary, all available energy and material flow data have been included in the model. In cases where no matching life cycle inventories are available to represent a flow, proxy data have been applied based on conservative assumptions regarding environmental impacts.

Data Quality

A variety of tests and checks were performed throughout the project to ensure high quality of the completed LCA. Checks included an extensive review of the LCA model as well as the background data used.

Temporal Representativeness

Primary fabrication data were collected for 12 consecutive months during the 2016/17 fiscal year. Most secondary data come from the GaBi 2017 databases and are representative of the years 2010-2017. Additionally, rebar mill data for some of Sherwood Steel's suppliers were obtained from recently published EPDs. Therefore, temporal representativeness is high.

Geographical Representativeness

All primary and secondary data were collected specific to the countries or regions under study. Whenever country-specific background data were not readily available, U.S., European, or global data were used as proxies. Geographical representativeness is considered to be high.

Technological Representativeness

Primary data were collected for the production of fabricated rebar by Sherwood Steel and thus represent the processes used by Sherwood Steel Ltd. Rebar production data represent manufacturing via electric arc furnace (EAF). All other data are either representative of North America or of the region- or country-specific technology mix (electricity grid and other inputs). Where technology-specific secondary data were unavailable, proxy data were used. Technological representativeness is considered to be high.

Precision

As the majority of the relevant foreground data are measured data or calculated based on primary information sources of the owner of the technology, precision is considered to be high. All background data are sourced from GaBi databases with the documented precision (www.gabi-software.com).

Completeness

Each unit process was checked for mass balance and completeness of the emission inventory. No foreground data were omitted in this study, although rebar input to fabrication was adjusted to ensure mass balance. All background data are sourced from GaBi databases with the documented completeness.

Consistency

To ensure consistency, all primary data were collected with the same level of detail (i.e., using consistent data collection templates), while background data were sourced from the GaBi 2017 databases, supplier EPDs or direct primary data. Allocation and other methodological choices were made consistently throughout the model.

Reproducibility

Reproducibility is supported as much as possible through the disclosure of input-output data, dataset choices, and modeling approaches. Based on information provided in the background LCA report, any third party should be able to approximate the results of this study using the same data and modeling approaches.

Sources of Data

Primary data for rebar fabrication were provided by Sherwood Steel Ltd. Secondary data were obtained from GaBi 2017 databases, supplier EPDs, and in one case, directly from a supplier. Data were cross-checked for completeness and plausibility, as well as when possible, benchmarked against existing numbers.

Uncertainty

Sherwood Steel Ltd. provided complete facility data. To ensure mass balance of the rebar fabrication process, input rebar was adjusted to equal fabricated rebar plus steel scrap outputs. While this may affect energy consumption per metric ton, Sherwood Steel's operations represent a small fraction of potential impact associated with A1-A3 so effect on results is expected to be minimal.

Allocation

Rebar production is not a multi-output process; thus, no multi-output allocation was needed for this project. All environmental burdens associated with the fabrication process were assigned to the fabricated rebar product.

LCA: Results

Results

Life cycle assessment results are presented per metric ton of steel product, the required reporting unit, and per short ton of steel product, the optional reporting unit. The product stage (modules A1-A3) has been aggregated into a single number for each metric. Primary energy use represents lower heating value.

Table 1: Product stage energy results per 1 metric and 1 short ton

Primary energy	Results per metric ton		Results per short ton	
Use of renewable primary energy resources excluding those used as raw materials	868	MJ	7.46E+05	BTU
Use of renewable primary energy as raw materials	0	MJ	0	BTU
Total use of renewable primary energy resources	**868**	**MJ**	**7.46E+05**	**BTU**
Use of non-renewable primary energy resources excluding those used as raw materials	13,200	MJ	1.13E+07	BTU
Use of non-renewable primary energy resources as raw materials	0	MJ	0	BTU
Total use of non-renewable primary energy resources	**13,200**	**MJ**	**1.13E+07**	**BTU**

Table 2: Product stage material resource results per 1 metric and 1 short ton

Material resource use	Results per metric ton		Results per short ton	
Use of secondary material	1.08	metric ton	1.08	short ton
Use of renewable secondary fuels	0	MJ	0	BTU
Use of non-renewable secondary fuels	0	MJ	0	BTU
Net use of fresh water	4.90	m^3	1,170	gallons

Table 3: Product stage waste and other environmental output results per 1 metric and 1 short ton

Waste or environmental output	Results per metric ton		Results per short ton	
Hazardous waste disposed	1.04E-08	metric ton	1.04E-08	short ton
Non-hazardous waste disposed	3.52E-02	metric ton	3.52E-02	short ton
Radioactive waste disposed	2.22E-04	metric ton	2.22E-04	short ton
Components for re-use	0	metric ton	0	short ton
Materials for recycling	6.50E-02	metric ton	6.50E-02	short ton
Materials for energy recovery	3.91E-05	metric ton	3.91E-05	short ton
Exported energy	0	MJ	0	BTU

Table 4: Product stage life cycle impact assessment results per 1 metric and 1 short ton

Impact category	Results per metric ton		Results per short ton	
Impact Assessment Method: TRACI 2.1				
Global warming potential (GWP100)	9.64E-01	metric ton CO_2 eq.	9.64E-01	short ton CO_2 eq.
Depletion potential of the stratospheric ozone layer (ODP)	6.53E-11	metric ton CFC-11 eq.	6.53E-11	short ton CFC-11 eq.
Acidification potential of soil and water (AP)	3.74E-03	metric ton SO_2 eq.	3.74E-03	short ton SO_2 eq.
Eutrophication potential (EP)	1.94E-04	metric ton N eq.	1.94E-04	short ton N eq.
Smog formation potential (SFP)	4.44E-02	metric ton O_3 eq.	4.44E-02	short ton O_3 eq.
Impact Assessment Method: CML2001 (version April 2013)				
Abiotic depletion potential (ADP-elements)†	1.55E-07	metric ton Sb eq.	1.55E-07	short ton Sb eq.
Abiotic depletion potential (ADP-fossil)	1.18E+04	MJ	1.02E+07	BTU

† This indicator is based on assumptions regarding current reserves estimates; therefore, caution is necessary when interpreting results because there is insufficient information on which indicator is best for assessing the depletion of abiotic resources.

LCA: Interpretation

Visualization of Life Cycle Impact Assessment

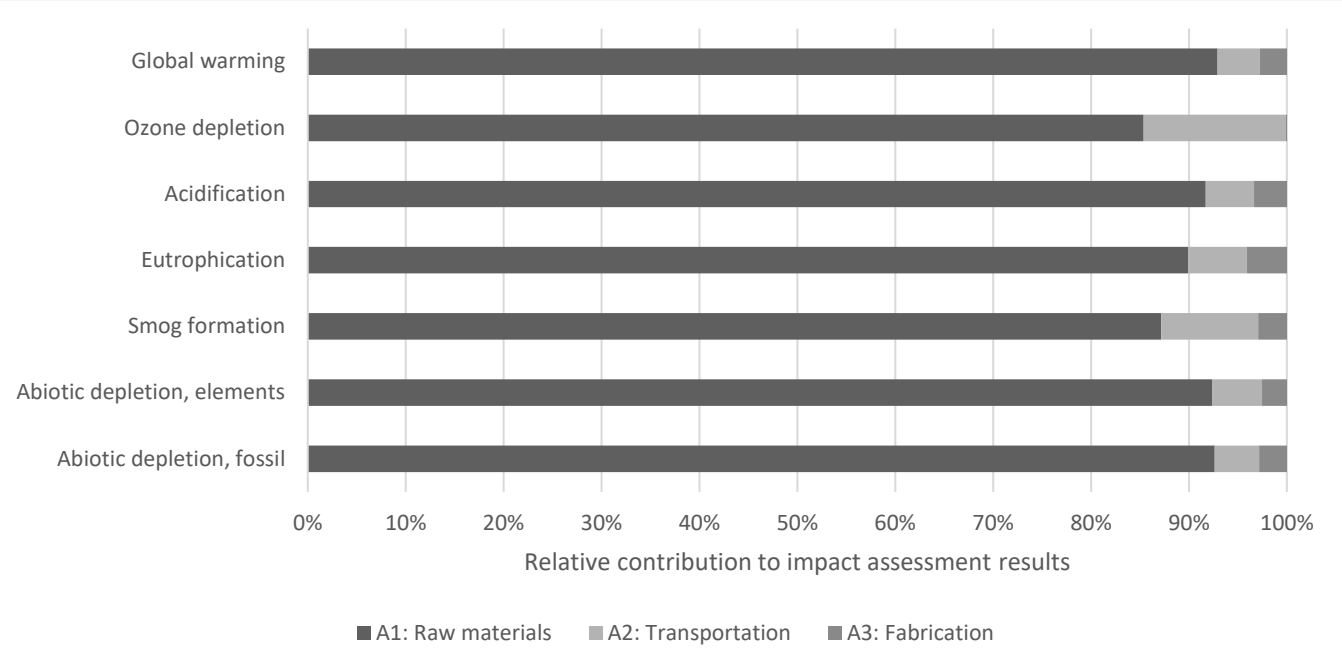

Figure 2: Relative contribution to life cycle modules to product stage impact assessment results

Disclaimer

This Environmental Product Declaration (EPD) conforms to ISO 14025, ISO 14040, ISO 14044, and ISO 21930 (ISO, 2007).

Scope of Results Reported: The PCR requires the reporting of a limited set of LCA metrics; therefore, there may be relevant environmental impacts beyond those disclosed by this EPD. The EPD does not indicate that any environmental or social performance benchmarks are met nor thresholds exceeded.

Accuracy of Results: This EPD has been developed in accordance with the PCR applicable for the identified product following the principles, requirements and guidelines of the ISO 14040, ISO 14044, ISO 14025 and ISO 21930 standards. The results in this EPD are estimations of potential impacts. The accuracy of results in different EPDs may vary as a result of value choices, background data assumptions and quality of data collected.

Comparability: EPDs are not comparative assertions and are either not comparable or have limited comparability when they cover different life cycle stages, are based on different product category rules or are missing relevant environmental impacts. Such comparisons can be inaccurate, and could lead to the erroneous selection of materials or products which are higher impact, at least in some impact categories. Any comparison of EPDs shall be subject to the requirements of ISO 21930. For comparison of EPDs which report different module scopes, such that one EPD includes Module D and the other does not, the comparison shall only be made on the basis of Modules A1, A2 and A3. Additionally, when Module D is included in the EPDs being compared, all EPDs must use the same methodology for calculation of Module D values.

References

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