



An Environmental Product Declaration

According to ISO 14025:2006 and ISO 21930:2017

A product-specific cradle-to-gate EPD for
Seaman Corporation's Shelter-Rite® 8324, 8028, & 9032 Architectural Fabrics



ASTM International Certified Environmental Product Declaration



This document is a Type III environmental product declaration (EPD) for Seaman Corporation’s Shelter-Rite® 8324, 8028, and 9032 Architectural Fabrics, as manufactured at its Wooster, OH facility.

This declaration has been prepared in accordance with ISO 14025 (1), ISO 21930 (2), ISO 14040/44 (3), (4), and ASTM’s General Program Instructions for Type III EPD (5).

The intent of this document is to further the development of environmentally compatible and more sustainable construction methods by providing comprehensive environmental information related to potential impacts of Seaman Corporation’s Shelter-Rite® architectural fabrics in accordance with international standards.

Environmental Product Declaration Summary

General Information	
Owner of the EPD	 <p>Seaman Corporation 1000 Venture Blvd. Wooster, OH 44691 Link (URL) https://www.seamancorp.com/</p> <p>Established in 1949, Seaman Corporation is a world leader of innovative, high performance coated fabrics in a number of markets for many different applications. Product lines include XR® Geomembrane liners and Shelter-Rite® Architectural Fabrics, FiberTite Roof Membranes, Truck Tarps, and Military Fabrics. In 1979, FiberTite Roof Systems was born from the XR technology and has become a worldwide market leader protecting operational security for critical facilities around the world.</p> <p><i>The owner of the declaration is liable for the underlying information and evidence.</i></p>
Manufacturing Site	Architectural Fabrics Wooster, OH 1000 Venture Blvd, Wooster, OH 44691
Product Group	Architectural Fabrics
Product Name	Seaman Corporation’s Shelter-Rite® 8324, 8028, and 9032 Architectural Fabrics



Product Category Rule (PCR)	ISO 21930:2017 Sustainability in buildings and civil engineering works – Core rules for environmental product declarations of construction products and services (2).
Certification Period	October 23 rd , 2024 – 5-year validity
Declared Unit	1 m ² manufactured of Seaman Corporation’s Shelter-Rite® 8324, 8028, and 9032 architectural fabrics.
ASTM Declaration Number	EPD #823

EPD Information

Program Operator	ASTM International 100 Barr Harbor Drive, PO Box C700 West Conshohocken, PA 19428-2959, USA https://www.astm.org/products-services/certification/environmental-product-declarations/epd-pcr.html
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Declaration Type
This “Cradle-to-gate” production stage EPD applies to the Seaman Corporation’s Shelter-Rite 8324, 8028, and 9032 architectural fabrics (all colors). Production activities covered include *the extraction and upstream production, transport to factory and manufacturing* (modules A1 to A3). The declaration is intended for Business-to-Business (B-to-B) communication.

Applicable Countries
United States and Canada

Product Applicability
Seaman Corporation’s architectural fabrics are water resistant membranes manufactured for use in air-supported, frame, tensile, and tent structures.

This EPD was independently verified by ASTM in accordance with ISO 14025:		 Tim Brooke 100 Barr Harbor Drive, PO Box C700 West Conshohocken, PA 19428-2959, USA https://www.astm.org/
Internal	<u>External</u> X	



EPD Project Report Information	
EPD Project Report	A Cradle-to-Gate Life Cycle Assessment of Seaman Corporation’s Architectural Fabrics, October 2024 (6).
<p>Prepared by</p> 	<p>Athena Sustainable Materials Institute 119 Ross Avenue, Suite 100 Ottawa, Ontario, K1Y 0N6, Canada info@athenasmii.org</p>
This EPD project report was independently verified by and in accordance with ISO 14025 and the reference PCR:	<p>Thomas P. Gloria, Ph.D. Industrial Ecology Consultants 35 Bracebridge Rd. Newton, MA 02459-1728</p>
EPD Explanatory material	<p>For any explanatory material regarding this EPD, please contact the program operator.</p> <p>ASTM International Environmental Product Declarations 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959, http://www.astm.org</p>



1 PRODUCT IDENTIFICATION

1.1 PRODUCT DEFINITION

Seaman Corporation’s architectural fabrics are single-ply polyester reinforced PVC membranes for use in air-supported, frame, tension, and tent structures. The architectural fabrics consist of four key components: the base fabric, adhesive or primer coat, exterior coatings, and top coating system. Seaman Corporation’s architectural fabrics are engineered using a proprietary coating formula that delivers superior UV and mildew resistance and are manufactured using unique weft-inserted knit fabric that provides excellent tensile, tear, and seam strength. The base fabric is knitted at Seaman Corporation’s Bristol, TN facility and shipped to the Wooster, OH facility for manufacturing of architectural fabrics. This EPD applies to Seaman Corporation’s Shelter-Rite® 8324, 8028, and 9032 architectural fabrics (all colors).

The three architectural fabric types covered in this EPD are similar in composition but vary in base fabric design and finished coated weight. Table 1 summarizes key technical data for Seaman Corporation’s Shelter-Rite® 8324, 8028, and 9032 architectural fabrics. For further product details, please refer to the specifications on Seaman Corporation’s Shelter-Rite® website:

<https://www.architecturalfabrics.com/products> (7)

Table 1. Finished Fabric Weight of Included Shelter-Rite® Architectural Fabrics (7)

Technical Data	Units	Seaman Corporation Shelter-Rite® Architectural Fabrics		
		8324	8028	9032 ¹
Finished Fabric Weight	g/m ²	815	950	1085

1.2 PRODUCT STANDARDS

Seaman Corporation’s architectural fabrics meet the following standards required by certain building codes:

1. NFPA 701 – Standard Methods of Fire Tests for Flame Propagation of Textiles and Films
2. ULC-S109 – Standard Method for Flame Tests of Flame-Resistant Fabrics and Films
3. Registered by California Fire Marshall

Detailed product specifications can be found on Seaman Corporation’s website at <https://www.architecturalfabrics.com/products> (7)

¹ The finished fabric weight for the 9032 architectural fabric does not include the opaque fabric, as the opaque fabric can be 140 g/m² heavier.



2 DECLARED UNIT

The declared product is 1 m² of Seaman Corporation's Shelter-Rite® 8324, 8028, and 9032 architectural fabrics.

3 MATERIAL CONTENT

The average material composition by input material (in %) for each of Seaman Corporation's Shelter-Rite® architectural fabrics covered in this EPD are provided in Table 2.

Table 2. Average material content for Seaman Corporation's Shelter-Rite® architectural fabrics

Material input	Material Content (in %)		
	8324	8028	9032
PVC Resin	29%	26%	26%
Polyester Scrim Fabric	16%	27%	28%
Plasticizer	24%	22%	24%
Fire Retardant	11%	7%	7%
Pigment	6%	7%	6%
Adhesive	4%	4%	4%
Tedlar® Film	6%	4%	3%
Other ¹	4%	3%	4%
Total weight (Input)	100%	100%	100%

¹ Other material input includes stabilizers, biocides, solvents, and epoxy resin



4 LIFE CYCLE STAGES

Figure 1 shows the life-cycle stages and information modules that are included within the cradle-to-gate LCA system boundary of this EPD. The boundary is “cradle-to-gate”, which includes the *Production stage* (A1 to A3 modules). *Construction, Use, and End-of-Life stages* - are excluded from the system boundary. The *Production stage* system boundary is shown in Figure 2. Per ISO 21930, 7.1.7.2.1 (2), the system boundary with nature (natural environment) includes those technical processes that provide the material and energy inputs into the system and the subsequent manufacturing and transport processes up to the factory gate, as well as the processing of any waste arising from those processes.

Production stage			Construction stage		Use stage							End-of-life stage			
Extraction and upstream production	Transport to factory	Manufacturing	Transport to site	Installation	Use	Maintenance	Repair	Replacement	Refurbishment	Operational Energy Use	Operational Water Use	De-Construction/ Demolition	Transport to waste processing or disposal	Waste processing	Disposal of waste
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4
X			MND												
X- module is included in system boundary; MND- module is not declared (excluded from system boundary)															

Figure 1. Life Cycle Stages and Modules

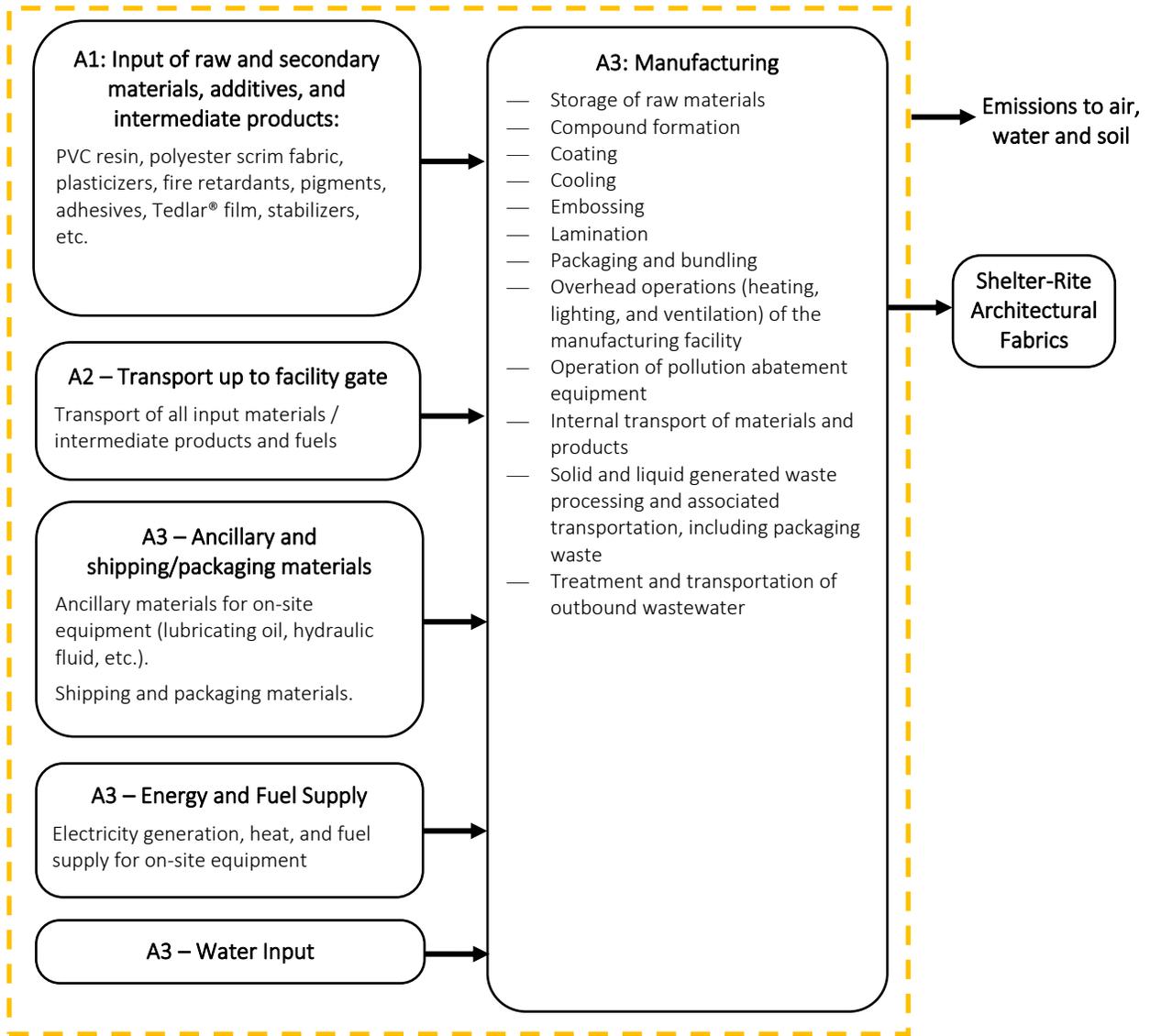


Figure 2. Seaman’s Corporation’s Architectural Fabric System Boundaries



5 LIFE CYCLE INVENTORY

5.1 DATA COLLECTION, SOURCES, AND CALCULATIONS

LCI data collection was based on one customized LCI survey. The LCI survey covered the primary data from the facility for the 2021 and 2023 reference years. Data calculation procedures follow ISO 14044 (4). Per ISO 21930, 7.2.2 (2), when transforming the inputs and outputs of combustible material into inputs and outputs of energy, the net calorific value (lower heating value) of fuels is applied according to scientifically based and accepted values specific to the combustible material.

5.2 DATA QUALITY REQUIREMENTS AND ASSESSMENTS

A detailed description of collected data and the data quality assessment regarding the ISO 14044 requirements (4) is provided in the LCA project report. Data quality is assessed based on its representativeness (technology coverage, geographic coverage, time coverage), completeness, consistency, reproducibility, transparency, and uncertainty (Table 3).

Table 3. Data Quality Requirements and Assessments

Data Quality Requirements	Description
Technology Coverage	Data represents the prevailing technology at Seaman Corporation’s plants in Wooster, OH and Bristol, TN. Whenever available, North American typical or average industry LCI datasets were utilized for all upstream and core material and processes. <i>Technological representativeness is characterized as “high”.</i>
Geographic Coverage	The geographic region considered is the U.S. <i>Geographical representativeness is characterized as “high”.</i>
Time Coverage	Activity data are representative. - Architectural fabric manufacturing process- primary data collected for the applicable reference year (12 months) - In-bound/ out-bound transportation data- primary data collected for the applicable reference year (12 months) - Polyester scrim reinforcement production- primary data collected at Bristol, TN plant for the applicable reference year (12 months) - Generic data: the most appropriate LCI datasets were used as found in the US LCI Database, ecoinvent v.3.9.1 database for US and Global, 2024. US LCI database “dummies” (empty/missing LCI datasets) are substituted with ecoinvent v3.9.1 LCI datasets. <i>Temporal representativeness is characterized as “medium” to “high”.</i>



Data Quality Requirements	Description
Completeness	All relevant, specific processes, including inputs (raw materials, energy, and ancillary materials) and outputs (emissions and production volume) were considered and modeled. The relevant background materials and processes were taken from the US LCI Database (adjusted for known data placeholders), ecoinvent v 3.9.1 LCI database for US, and modeled in SimaPro software v.9.5.0.2, 2024 (8). The completeness of the cradle-to-gate process chain in terms of process steps is rigorously assessed for all membranes and documented in project report.
Consistency	To ensure consistency, the input/output LCI modeling of the architectural fabrics used the same LCI modeling structure, which consisted of input raw, secondary, ancillary, and packaging materials, intermediate products, energy flows, water resource inputs, product outputs, co-products, by-products, emissions to air, water and soil, and solid and liquid waste disposal. Crosschecks concerning the plausibility of mass and energy flows were continuously conducted. The LCA team conducted mass and energy balances at the facility level and selected process levels to maintain a high level of consistency.
Reproducibility	Internal reproducibility is possible since the data and the models are stored and available in <i>Athena Seaman LCI database</i> developed in SimaPro, 2021 (8). A high level of transparency is provided throughout the reviewed LCA project report as the LCI profile is presented for each of the declared products as well as major upstream inputs. Key primary (manufacturer specific) and secondary (generic) LCI data sources are summarized in the supporting LCA project report.
Transparency	Activity and LCI datasets are transparently disclosed in the project report, including data sources.
Uncertainty	A <i>sensitivity check</i> was conducted to assess the reliability of the EPD results and conclusions by determining how they are affected by uncertainties in the data or assumptions on calculation of LCIA and energy indicator results. The LCA background report includes the results of a <i>sensitivity analysis</i> and <i>Monte Carlo uncertainty analysis of background data sets</i> .

5.3 ALLOCATION RULES

Per ISO 21930 section 3 (2), a co-product is defined as one or more products from the same unit process, but which is not the object of the assessment. The Wooster, OH manufacturing facility procures high-performance fabrics and membranes for other uses besides the architectural fabrics of interest, therefore allocation based on the mass of membrane products produced was necessary.

Mass based, facility-specific formulation for 1 m² of each architectural fabric type were collected from the facility to calculate the input materials. No allocation has been performed for raw material inputs.

Mass based allocation has been performed on several flows which have not been provided specific to the product system, such as energy flows (electricity, natural gas, propane, etc.), shipping and packaging materials, lubricants, hydraulic fluid, greases and heating oil, water



consumption, process emissions to air, and final waste flows. No burden is allocated to the by-product of the declared product system such as off-spec architectural fabrics. In addition, allocation related to transport is based on the mass of transported inputs and outputs.

5.4 CUT OFF RULES

The cut-off criteria as per ISO 21930, 7.1.8 (2) were followed. All input/output data reported by the Wooster, OH manufacturing plant was included in the LCI modelling. None of the reported flow data were excluded based on the cut-off criteria. No substances with hazardous and toxic properties that pose a concern for human health and/or the environment were identified in the framework of this EPD. Any plant specific data gaps for the reference year (e.g., input hydraulic fluids, lubricants, greases, or heated oil) were filled in with plant generic data from 2018. Chemical composition information was confidentially provided by Seaman Corporation for each additive e.g., processing aid (also referred to as the plasticizer), fire retardant, stabilizer, pigments, adhesives, etc. Any data gaps in the chemical composition information are filled in with proxy and conservative generic LCI datasets, as appropriate.

This EPD excludes the following processes:

- Capital goods and infrastructure, and
- Personnel related activity (travel, furniture, office operations and supplies).

6 LIFE CYCLE ASSESSMENT RESULTS

Table 4 presents the “cradle-to-gate” LCA results for 1 m² of Seaman Corporation’s Shelter-Rite® 8324, 8028, and 9032 architectural fabrics.

The US EPA Tool for the Reduction and Assessment of Chemical and Other Environmental Impacts (TRACI), version 2.1, 2012 (9) impact categories are used as they provide a North American context for the mandatory category indicators to be included in this EPD. *These are relative expressions only and do not predict category impact endpoints, the exceeding of thresholds, safety margins or risks* [4], [5]. Additionally, several LCA impact categories and inventory items are still under development and can have high levels of uncertainty that preclude international acceptance pending further development. Use caution when interpreting data in these categories, which are identified with an asterisk (“*”).



Table 4. Production Stage (A1-A3) EPD results for 1 m² of Seaman Corporation's Shelter-Rite® 8324, 8028, and 9032 Architectural Fabrics

Impact category and inventory indicators	Unit	Shelter-Rite® Architectural Fabrics A1-A3 Total		
		8324	8028	9032
Global warming potential, GWP 100 ¹⁾	kg CO ₂ eq	5.6	5.8	6.4
Ozone depletion potential, ODP ¹⁾	kg CFC-11 eq	9.9E-08	9.7E-08	1.1E-07
Smog formation potential, SFP ¹⁾	kg O ₃ eq	4.1E-01	3.7E-01	4.1E-01
Acidification potential, AP ¹⁾	kg SO ₂ eq	3.1E-02	3.1E-02	3.3E-02
Eutrophication potential, EP ¹⁾	kg N eq	2.4E-02	2.5E-02	2.9E-02
Fossil fuel depletion, FFD ¹⁾	MJ surplus	9.8	11.0	12.2
Abiotic depletion potential, fossil ADPF ²⁾	MJ LHV	75.2	83.4	92.5
Renewable primary resources used as an energy carrier (fuel), RPR _E [*]	MJ LHV	13.9	14.4	17.0
Renewable primary resources with energy content used as material, RPR _M ^{*3)}	MJ LHV	-	-	-
Non-renewable primary resources used as an energy carrier (fuel), NRPR _E [*]	MJ LHV	67.2	73.7	80.2
Non-renewable primary resources with energy content used as material, NRPR _M ^{*3)}	MJ LHV	20.3	23.7	27.7
Secondary materials, SM ^{*3)}	kg	-	-	-
Renewable secondary fuels, RSF ^{*3)}	MJ LHV	-	-	-
Non-renewable secondary fuels, NRSF ^{*3)}	MJ LHV	-	-	-
Recovered energy, RE ^{*3)}	MJ LHV	-	-	-
Consumption of freshwater, FW ^{*3)}	m ³	1.3E-03	1.3E-03	1.3E-03
Hazardous waste disposed, HWD ^{*3)}	kg	5.2E-02	5.2E-02	5.2E-02
Non-hazardous waste disposed, NHWD ^{*3)}	kg	0.150	0.154	0.160
High-level radioactive waste, conditioned, to final repository, HLRW ^{*3) 4)}	m ³	6.6E-09	7.3E-09	7.9E-09
Intermediate- and low-level radioactive waste, conditioned, to final repository, ILLRW ^{*3) 4)}	m ³	7.7E-08	8.7E-08	9.4E-08
Components for re-use, CRU ^{*3)}	kg	-	-	-
Materials for recycling, MR ^{*3)}	kg	2.3E-03	4.3E-03	5.2E-03
Materials for energy recovery, MER ^{*3)}	kg	-	-	-
Recovered energy exported from the product system, EE ^{*3)}	MJ LHV	-	-	-



Notes:

¹⁾ Calculated as per U.S EPA TRACI 2.1, v1.05, SimaPro v 9.5.0.2 GWP-100 (8), excludes biogenic CO₂ removals and emissions associated with any biobased products, including bio-based packaging. There is no biogenic content in the declared products. CO₂ emissions from calcination and carbonation are not applicable to the declared products; 100-year time horizon GWP factors are provided by the IPCC 2013 Fifth Assessment Report (AR5), TRACI 2.1, v1.05 (9). FFD is required in LEED V4.1 MR Credit: Building Product Disclosure and Optimization – Environmental Product Declarations (10).

²⁾ Calculated as per CML-IA Baseline v3.05, SimaPro v 9.5.0.2 (8). ADP_F is also required in LEED v4.0/v4.1 MR2 Credit: Building Product Disclosure and Optimization – Environmental Product Declarations (11), (10).

³⁾ Calculated as per ACLCA ISO 21930 Guidance (12), respective sections 6.2 to 10.8.

⁴⁾ It should be noted that the foreground system (Seaman Corporation architectural fabric manufacturing process) does not generate any HLRW or ILLRW. High, intermediate or low-level radioactive waste is generated by electricity production (spent fuel from reactors, routine facility maintenance and operations)” (ISO 21930:2017, clause 7.2.14). High-level radioactive waste, e.g., when generated by electricity production, consists mostly of spent fuel from reactors.” (ISO 21930:2017, clause 7.2.14).

7 INTERPRETATION

Seaman Corporation’s Shelter-Rite® EPD results represent a “cradle-to-gate” environmental profile per 1 m² for each declared architectural fabric as manufactured at its Wooster, OH plant.

Module A1 Extraction and upstream production contributes the largest share of the LCIA category indicator results, accounting for between 66% and 97% of the *Production stage* (A1 to A3) potential environmental burdens. *Module A3 Manufacturing* is the second largest contributor to the overall potential environmental impacts of the membrane manufacture. Approximately 85% of the total primary energy is derived from *non-renewable primary energy resource* (NRPR_E) for all membrane types. *Module A2 transportation* significantly contributes to the smog formation potential but otherwise contributed less than 10% to the other environmental indicator metrics.

8 ADDITIONAL ENVIRONMENTAL INFORMATION

Seaman Corporation utilizes regenerative thermal oxidizers (RTO) to limit emissions of process VOCs. Seaman Corporation also utilizes high efficiency fabric filters to limit emissions of particulates.



9 DECLARATION TYPE

This “Cradle-to-gate” EPD applies to Seaman Corporation’s Shelter-Rite® 8324, 8028, and 9032 architectural fabrics (all colors). Production activities covered include *the extraction and upstream production, transport to factory, manufacturing* (modules A1 to A3). The declaration is intended for Business-to-Business (B-to-B) communication.

The three declared products of Shelter-Rite® architectural fabric fall under the description:
A product-specific EPD, from one manufacturer plant.

10 EPD COMPARABILITY LIMITATION STATEMENT

Only EPDs prepared from cradle-to-grave life cycle results and based on the same function, RSL, quantified by the same functional unit, and meeting all the conditions for comparability listed in ISO 14025:2006 and ISO 21930:2017 can be used to make comparison between products.



11 REFERENCES

1. ISO 14025: 2006 Environmental labeling and declarations - Type III environmental declarations - Principles and procedures.
2. ISO 21930:2017 Sustainability in buildings and civil engineering works - Core rules for environmental product declarations of construction products and services.
3. ISO 14040/Amd1:2020 Environmental Management – Life Cycle Assessment – Principles and Framework, International Organization for Standardization, 2006.
4. ISO 14044/Amd1:2017/Amd2:2020 Environmental Management – Life Cycle Assessment – Requirements and guidelines, International Organization for Standardization, 2006.
5. ASTM Program Operator for Product Category Rules (PCRs) and Environmental Product Declarations (EPDs), General Program Instructions, Version 8.0, 04/29/20.
6. Athena Sustainable Materials Institute, A Cradle-to-Gate Life Cycle Assessment of Seaman Corporation’s Architectural Fabrics, October 2024.
7. Shelter-Rite® Products. Seaman Corporation Shelter-Rite® Architectural Fabrics. [Online] Seaman Corporation. <https://www.architecturalfabrics.com/products>.
8. PRé 2021.SimaPro LCA Software v 9.5.0.2, 2024, <https://simapro.com/>.
9. Bare, J., TRACI 2.0: The Tool for the Reduction and Assessment of Chemical and Other Environmental Impacts 2.0. Clean Technologies and Environmental Policy 2011, 13, (5), <https://link.springer.com/article/10.1007/s10098-010-0338-9#page-1>.
10. LEED v4.1, MRc2: Building product disclosure and optimization, Environmental Product Declarations,. <https://leeduser.buildinggreen.com/credit/NC-v4.1/MRc2#tab-credit-language> .
11. LEED v4, MRc2: Building product disclosure and optimization, Environmental Product Declarations, <https://leeduser.buildinggreen.com/credit/NC-v4/MRc2#tab-credit-language>.
12. ACLCA 2019, Guidance to Calculating Non-LCIA Inventory Metrics in Accordance with ISO 21930:2017. The American Centre for Life Cycle Assessment. May, 2019.