EPD®

Environmental Product Declaration

According to ISO 14025 and EN 15804

SPACELOFT® AEROGEL INSULATION

Declaration number S-P-00725

Renuables
LCA // MATERIALS // ENERGY








1 | General Information

Aspen Aerogels Inc.

EPD programme holder
The International EPD® System. For more information see **www.environdec.com**

Registration number
S-P-00725

This Declaration is based on the Product Category Rules:
The International EPD® System PCR 2014:13 Version 1.0 for Product Group: Multiple UN CPC Codes, Insulation Materials.
EN 15804 Sustainability of construction works Environmental product declarations Core rules for the product category of construction products.

Issue date
18th September 2015

Valid to
18th September 2020

Owner of the Declaration
Aspen Aerogels, Inc.
30 Forbes Road
Bldg. B
Northborough
MA 01532
USA

EPD Prepared by
Professor Callum Hill, Renuables.
For more information see **www.renuables.co.uk**

Spaceloft®

Declared product/Declared unit
The declared unit is 1 m^2 of Spaceloft® @ 10mm thickness. Data is reported for Spaceloft® White/Grey (weight 1.5 kg) and separately for Spaceloft® A2 (weight 2.0 kg).

Scope:
The LCA is based on June 2012-to June 2013 production data for Spaceloft®. This EPD covers information modules A1 to A4 (cradle to delivery at construction site) as defined in EN15804:2012. This EPD is valid for business to business (b2b) communication only.

This EPD is valid within the following geographical area:
Europe

PCR review conducted by:
The Technical Committee of the International EPD System. Chair: Massimo Marino. Contact via **info@environdec.com**

EPDs of construction products may not be comparable if they do not comply with EN 15804.

CEN standard EN 15804 serves as the core PCR[a]

Independent verification of the declaration, according to EN ISO 14025:2010

☐ Internal ☒ External

Third party verifier[b]:
Dr Andrew Norton. Approved by the International EPD System

a Product Category Rules
b Optional for business-to-business communication; mandatory for business to consumer communication (see EN ISO 14025:2010, 9.4)

2 | Product

2.1 | Company Description

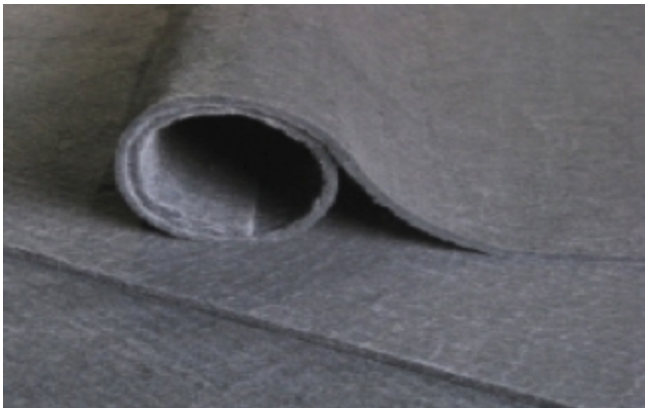
Aspen Aerogels (www.aerogel.com) supplies reinforced, flexible aerogel insulation products that provide up to five times the thermal performance of traditional insulation materials. Aspen's aerogel insulation delivers thermal and other benefits that enable customers to conserve energy and to save money. Aspen's products are used in many industries including oil and gas production and processing, LNG transportation and storage, building and construction, outdoor apparel, appliances, transportation and aerospace.

Headquartered in Northborough, Mass., Aspen manufactures its Cryogel®, Pyrogel® and Spaceloft® line of products at its East Providence, R.I., facility.

In 2012 Aspen Aerogels was inducted into the Space Technology Hall of Fame, recognising the company's commitment to the development of mission critical insulation solutions for the space sector.

2.2 | Product Description

Spaceloft® is an ultra-high performance, fibre reinforced, silica aerogel blanket thermal insulation. Spaceloft® combines the outstanding insulating power of air trapped in a nano-porous silica foam matrix with a robust fibre reinforced blanket form.



Spaceloft® is water vapour permeable, yet highly hydrophobic and is manufactured in roll form in 5mm and 10mm thicknesses.

This EPD applies to 1m^2 of Spaceloft® 10mm thickness for the White/Grey product and the Spaceloft® A2 product.

2.3 | Application

Spaceloft® is intended for use as a primary or secondary thermal insulation in:

- Walls – internal & external
- Floors – screed & floating
- Ceilings – flat & sloped
- Roofs, terraces & balconies
- Services, pipework, ducting etc.

In each case, where it is not exposed to wetting or weathering.

Spaceloft® can also be used as a highly effective treatment to address thermal bridges in a variety of construction applications.

Spaceloft® may be used in single layers or assembled into engineered laminations as necessary to deliver target R values.

Spaceloft® is suitable for use as a thermal performance upgrade in new, modern and historic buildings.

2.4 | Technical data Standards and Certification

European Technical Approval, ETA 11_0471 governs the use of Spaceloft® as a thermal insulation in various Building and Construction applications.

Construction data

Characteristic	Value	Unit
Calculation value for thermal conductivity - λ_D EN 12667	0.015	W/(mK)
Water vapour diffusion resistance factor EN 12086	5	-
Water vapour diffusion equivalent air layer thickness	0.05	m
Euro Fire Class EN 13501-1	C-s1-d0	
Gross density (Spaceloft® white/grey) Gross density (Spaceloft® A2)	150 200	kg/m^3 kg/m^3
Compressive strength σ EN 826	σ_{10} > 80	kPa
Upper Service Temperature	+200	°C

Certifications

Spaceloft® is manufactured under an ISO 9001:2008 Quality Management System.

2.5 | Placing on the market/application rules

Spaceloft® is intended to provide a minimum 50 year service life provided that the conditions laid down in sections 4.2, 5.1 and 5.2 of the European Technical Approval 11_0471 relating to packaging, transport, storage, installation, use, maintenance and repair are met.

As with any insulation upgrade/application, a risk assessment should be performed to determine suitability of Spaceloft® for the intended application. An enhanced data set for Spaceloft hygro-thermal characterisation is available on request.

2.6 | Delivery Status

Spaceloft® is supplied in roll format, approximately $45m^2$ to $75m^2$ per roll for 10mm material (also available in $150m^2$ for 5mm).

Each roll is approximately 1.45m wide. Rolls may be crated for individual or air shipment or stretch-wrapped for group shipment.

2.7 | Base materials/Ancillary materials

Material	Part
Silica	40 - 55
PET/glass fibre*	20 - 45
Additives	0 - 15
Total	**100%**

**Spaceloft® A2 – Glass Fibre only*

No additives used are classified as substances of concern but as proprietary information they are not listed specifically.

2.8 | Manufacture

Spaceloft® combines the outstanding insulating properties of air trapped in a nano-porous foam matrix with a robust fibre reinforced blanket form.

The aerogel preparation is added to the textile batting resulting in a homogenous aerogel distribution. The aerogelised blanket is then subjected to additional proprietary process steps before preparation and shipping.

The main process steps are highlighted in the flow diagram below.

Spaceloft® Production Process

2.9 | Environment and health during manufacturing

The Aspen Aerogel plant at East Providence operates using an Environmental Management System.

2.10 | Specific Health and Safety Information

The aerogel component of Spaceloft® is synthetic amorphous (non-crystalline) silica with 97% of particles larger than 45µm. Only the pores are nano-scale.

Wearing of the following personal protective equipment (PPE) while working with Spaceloft® is recommended.

- Safety Eyeglasses
- P100 or equivalent respirator
- Gloves

There is no associated health risk from ingestion or absorption through the skin, however some may find the use of a barrier cream and or wearing of suitable gloves and clothing more comfortable. There is no specific requirement beyond normal site hygiene practices for washing of hands before meals.

Spaceloft® dust is extremely hydrophobic, use soap when washing. Work-wear can be laundered as normal.
For further information refer to the Spaceloft® Safety Data Sheet.

2.11 | Product processing/Installation General

Cutting

Spaceloft®, in blanket or laminate form can be cut and shaped with a variety of commonly used construction tools. Best results can be achieved with the following hand and machine tools and applying light compression to the work piece.

Hand	Machine
Ceramic Knife	Tungsten Carbide tipped rotary saw
Heated Knife	Angle Grinder

It is not recommended to use a hand saw or jig saw when cutting Spaceloft®.

Fixing

Where required, Spaceloft® should be secured tightly to the substrate using appropriate mechanical fixings. The Spaceloft® layer should be butted tightly to ensure continuity of thermal performance and avoid thermal looping.

Spaceloft® has excellent tensile strength parallel to the blanket face. However Spaceloft® should be mechanically fixed especially where perpendicular/transverse loading is expected.

The type and length of mechanical fixings should be selected according to local fire standards and should be of polymer and/or stainless steel construction to minimise point thermal bridging

Decoration

Spaceloft® can be finished with a tough impact layer such as

- Gypsum
- Wood Fibre board
- Magnesium Silicate Board
- Calcium Silicate Board
- Cement Fibre board

It is possible to directly plaster the following finishes on to Spaceloft® (surface priming may be required)

- Lime
- Gypsum
- Clay
- Sand & Cement
- Polymer modified coatings

The finish will generally require a mechanically fixed reinforcing mesh to support the weight of the render or plaster. It is recommended to prepare a test area in advance, consult with system designer first.

The thickness of the primer/finishing coat should follow manufacturers' recommendations; it is strongly advisable that the installer should test an area of Spaceloft® for adhesion/drying time before addressing the main work area.

2.12 | Packaging

Spaceloft® is supplied in roll format, wrapped in a recyclable stretch film or in a wooden crate. Packaging can be recycled through existing site waste streams.

2.13 | Condition of use

Products containing Spaceloft® should be stored in a clean, dry and protected environment.

If material has to be stored in an outdoor setting, it should be placed on pallets and thoroughly covered with a waterproof tarp or plastic sheeting.

Spaceloft®, in composite panel or roll form should be stored in its protective packaging until required. Prevent direct exposure to the weather.

2.14 | Environment and health during use

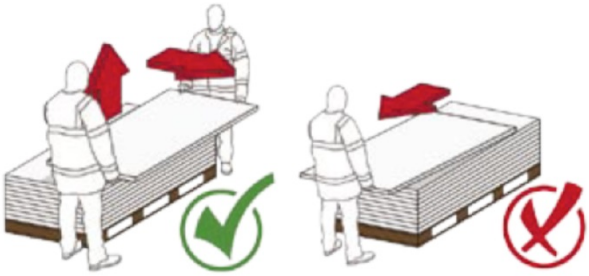
Wearing of the following personal protective equipment (PPE) while working with Spaceloft® is recommended:

- Safety Eyeglasses
- P100 or equivalent respirator

There is no associated health risk from ingestion or absorption through the skin however some may find the use of a barrier cream and wearing of suitable gloves or clothing more comfortable.

There is no specific requirement beyond normal site hygiene practices for washing of hands before meals.

Spaceloft® offcuts can be reused on site or retained for later use in thermal bridging applications.



Spaceloft® containing products are delivered to site on pallets/in rolls with labels identifying the product name and dimensions. Spaceloft® weighs approx. 1.5 kg / m^2 and Spaceloft® A2 weighs 2.0 kg / m^2, of 10mm, according to the final composition more than one person may be required to lift. Refer to local site safety risk assessments and safe systems of work.

2.15 | Reference service life

ETA 11_0471 assumes a working life of 50 years for Spaceloft® if stored and used appropriately.

2.16 | Extraordinary effects

Fire
Spaceloft® is classified as C,s1,d0 according to EN 13510-1

Name	Value
Building material class	C
Burning droplets	d0
Smoke gas development	s1

Spaceloft® does not contain any substances which have to be classified as dangerous according to Directive 67/548/EEC and Regulation (EC) No. 1272/2008 and/or listed in the "indicative list on dangerous substances" of the EDGS – taking into account the installation conditions.

Spaceloft® carries an M1 certificate from the Finnish Institute of Occupational Health. – report 120820

Spaceloft® does not contain any substances listed in annex 14 of REACH.

Water
Spaceloft® is water vapour permeable (μ=5), hydrophobic and non-capillary active.

Spaceloft® is inert and is not expected to release any substances when subjected to unforeseen exposure to water.

Mechanical destruction/damage
Spaceloft® should be protected from impact or foot traffic during installation to avoid damage to the insulation performance.

Use of unsuitable cutting tools and/or rough handling onsite may cause the insulation layer to release aerogel dust. This dust is not injurious to human health but can be uncomfortable in enclosed, poorly ventilated working environments.

2.17 | Re-use phase

Spaceloft® is generally installed mechanically and can be recovered for secondary use or recycling. Offcuts can be retained for use in thermal bridging applications or processed into loose-fill insulation with or without the fibrous textile element.

2.18 | Disposal

Spaceloft® can be mechanically recycled into its main component parts

- Polyester/Glass Fibre
- Silica Aerogel

Waste channels exist for the textile component while the silica component can re-used as a particulate insulation in loose fill, mortars, renders, paints etc.

The silica aerogel component of Spaceloft® is inert and can be introduced to landfill.

2.19 | Further Information

Additional product information, characterisation data, hygro-thermal risk assessments and case studies are available. Application guidelines and detail drawings are also available on request.

All enquiries to **info@aerogel.com**

3 | LCA: Calculation rules

3.1 | Declared unit

The declared unit is 1 m^2 of Spaceloft® of thickness 10 mm.

Name	Value	Unit
Declared unit	1	m^2
Gross density (White/Grey)	150	kg/m^3
Gross density (A2)	200	kg/m^3

3.2 | System boundary

The LCA addresses the life cycle stages from cradle to delivery at construction site in Europe. This includes stages A1 – A3 and A4 as per EN 15804.

3.3 | Estimates and assumptions

Primary data was gathered from the East Providence production site in the USA for 2012/13. A site visit was made in July 2013.

3.4 | Cut-of criteria

All known raw material inputs are included in the study.

3.5 | Background data

All primary data was provided by Aspen Aerogel Inc. All secondary data was retrieved using SimaPro software using Ecoinvent 2.2 (2010) and ELCD databases.

3.6 | Data quality

Primary data was gathered for a 12 month period during the years 2012-2013 for the Aspen Aerogel production facility in East Providence, Rhode Island, USA. Current Ecoinvent and ELCD databases have been used for other relevant background data.

3.7 | Period under review

The data is representative of the manufacturing processes of 2012-2013.

3.8 | Allocation

Allocation has been based on product specific data. Where this is not possible, e.g. in the case of energy allocations, then this has been made on the basis of a mass allocation.

3.9 | Compatibility

A comparison or an evaluation of EPD data is only possible where EN15804 has been followed, the same building context and product-specific characteristics of performance are taken into account, and the same stages have been included in the system boundary.

4 | LCA: Scenarios and additional technical information

The underlying LCA comprises the compulsory modules A1-A3 and also includes transport to a building site in Europe from the USA production facility. Modules A4-D do not form part of the analysis. Two Spaceloft® products have been analysed (White/Grey, A2). The gross density of the Spaceloft® White/Grey product is 150 kg/m^3 and that of the Spaceloft® A2 product 200 kg/m^3. The declared unit is 1 m^2 of 10 mm thickness of Spaceloft® product.

Transport to the building site (A4)

Parameter	Value	Unit
Transport distance production site to port (USA)	100	km
Transport distance USA to Europe	5600	km
Transport distance within Europe	400	km

5 | LCA: Results

Description of the system boundary (X = Included in LCA, MNA = Module Not Assessed)

Product Stage			Construction Stage		Use Stage							End of Life Stage				Benefits and loads beyond the system boundary
Raw material supply	Transport	Manufacturing	Transport	Construction-Installation process	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	X	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA	MNA

LCA Results of Spaceloft® White/Grey

Environmental impacts (Per 1 m^2 of Spaceloft® White/Grey)

Parameter	Unit	Product Stage	Construction Stage	Use Stage	End of Life Stage	Total
Global warming potential	kg CO_2 eq	1.23E+01	1.80E-01	n/a	n/a	1.25E+01
Ozone depletion potential	kg CFC 11 eq	3.39E-06	2.50E-08	n/a	n/a	3.42E-06
Acidification potential	kg SO_2 eq	5.81E-02	2.29E-03	n/a	n/a	6.03E-02
Eutrophication potential	kg $(PO_4)^{3-}$ eq	5.94E-03	2.66E-04	n/a	n/a	6.20E-03
Photochemical ozone creation potential	kg ethene eq	4.08E-03	7.70E-05	n/a	n/a	4.16E-03
Abiotic depletion potential (elements)	kg Sb eq	4.87E-05	1.99E-07	n/a	n/a	4.89E-05
Abiotic depletion potential (fossil fuels)	MJ	9.13E+01	2.79E-01	n/a	n/a	9.16E+01

Resource use (per 1 m^2 of Spaceloft® White/Grey)

Parameter	Unit	Product Stage	Construction Stage	Use Stage	End of Life Stage	Total
Renewable primary energy excluding renewable primary energy resources used as raw materials	MJ	1.39E+01	3.07E-02	n/a	n/a	1.39E+01
Renewable primary energy resources used as raw materials	MJ	3.68E+00	1.97E-03	n/a	n/a	3.68E+00
Total use of renewable primary energy resources (primary energy and primary energy resources used as raw materials)	MJ	1.76E+01	3.26E-02	n/a	n/a	1.76E+01
Non-renewable primary energy excluding non-renewable primary energy resources used as raw materials	MJ	2.39E+02	2.92E+00	n/a	n/a	2.42E+02
Non-renewable primary energy resources used as raw materials	MJ	0.00E+00	0.00E+00	n/a	n/a	0.00E+00
Non-renewable primary energy sources (primary energy and primary energy sources used as raw materials)	MJ	2.39E+02	2.92E+00	n/a	n/a	2.42E+02
Secondary material	kg	0.00E+00	0.00E+00	n/a	n/a	0.00E+00
Renewable secondary fuels	MJ	1.06E-01	8.71E-04	n/a	n/a	1.07E-01
Non-renewable secondary fuels	MJ	0.00E+00	0.00E+00	n/a	n/a	0.00E+00
Use of net fresh water	m^3	6.79E-02	5.79E-04	n/a	n/a	6.85E-02

Waste categories
(per 1 m^2 of Spaceloft® White/Grey)

Parameter	Unit	Product Stage	Construction Stage	Use Stage	End of Life Stage	Total
Hazardous waste disposed	kg	9.14E-02	0.00E+00	n/a	n/a	9.14E-02
Non-hazardous waste disposed (total for life cycle inc. installation materials)	kg	5.96E-03	0.00E+00	n/a	n/a	5.96E-03
Radioactive waste disposed	kg	0.00E+00	0.00E+00	n/a	n/a	0.00E+00

Output flows
(per 1 m^2 of Spaceloft® White/Grey)

Parameter	Unit	Product Stage	Construction Stage	Use Stage	End of Life Stage	Total
Components for re-use	kg	0.00E+00	0.00E+00	n/a	n/a	0.00E+00
Materials for recycling	kg	0.00E+00	0.00E+00	n/a	n/a	0.00E+00
Materials for energy recovery	kg	1.96E-02	0.00E+00	n/a	n/a	1.96E-02
Exported energy	MJ	0.00E+00	0.00E+00	n/a	n/a	0.00E+00

LCA Results of Spaceloft® White/Grey

Environmental impacts
(per 1 m^2 of Spaceloft® A2)

Parameter	Unit	Product Stage	Construction Stage	Use Stage	End of Life Stage	Total
Global warming potential	kg CO_2 eq	1.28E+01	2.41E-01	n/a	n/a	1.30E+01
Ozone depletion potential	kg CFC 11 eq	2.74E-06	3.33E-08	n/a	n/a	2.77E-06
Acidification potential	kg SO_2 eq	6.52E-02	3.06E-03	n/a	n/a	6.83E-02
Eutrophication potential	kg $(PO_4)^{3-}$ eq	5.93E-03	3.55E-04	n/a	n/a	6.29E-03
Photochemical ozone creation potential	kg ethene eq	3.74E-03	1.03E-04	n/a	n/a	3.84E-03
Abiotic depletion potential (elements)	kg Sb eq	8.19E-05	2.65E-07	n/a	n/a	8.21E-05
Abiotic depletion potential (fossil fuels)	MJ	9.91E+01	3.72E-01	n/a	n/a	9.95E+01

Resource use (per 1 m^2 of Spaceloft® A2)

Parameter	Unit	Product Stage	Construction Stage	Use Stage	End of Life Stage	Total
Renewable primary energy excluding renewable primary energy resources used as raw materials	MJ	1.16E+01	4.09E-02	n/a	n/a	1.17E+01
Renewable primary energy resources used as raw materials	MJ	3.16E+00	2.62E-03	n/a	n/a	3.16E+00
Total use of renewable primary energy resources (primary energy and primary energy resources used as raw materials)	MJ	1.48E+01	4.35E-02	n/a	n/a	1.48E+01
Non-renewable primary energy excluding non-renewable primary energy resources used as raw materials	MJ	2.31E+02	3.90E+00	n/a	n/a	2.35E+02
Non-renewable primary energy resources used as raw materials	MJ	0.00E+00	0.00E+00	n/a	n/a	0.00E+00
Non-renewable primary energy sources (primary energy and primary energy sources used as raw materials)	MJ	2.31E+02	3.90E+00	n/a	n/a	2.35E+02
Secondary material	kg	0.00E+00	0.00E+00	n/a	n/a	0.00E+00
Renewable secondary fuels	MJ	9.44E-02	1.16E-03	n/a	n/a	9.56E-02
Non-renewable secondary fuels	MJ	0.00E+00	0.00E+00	n/a	n/a	0.00E+00
Use of net fresh water	m^3	8.00E-02	7.72E-04	n/a	n/a	8.07E-02

Waste categories (per 1 m^2 of Spaceloft® A2)

Parameter	Unit	Product Stage	Construction Stage	Use Stage	End of Life Stage	Total
Hazardous waste disposed	kg	1.22E-01	0.00E+00	n/a	n/a	1.22E-01
Non-hazardous waste disposed (total for life cycle inc. installation materials)	kg	7.95E-03	0.00E+00	n/a	n/a	7.95E-03
Radioactive waste disposed	kg	0.00E+00	0.00E+00	n/a	n/a	0.00E+00

Output flows (per 1 m^2 of Spaceloft® A2)

Parameter	Unit	Product Stage	Construction Stage	Use Stage	End of Life Stage	Total
Components for re-use	kg	0.00E+00	0.00E+00	n/a	n/a	0.00E+00
Materials for recycling	kg	0.00E+00	0.00E+00	n/a	n/a	0.00E+00
Materials for energy recovery	kg	1.96E-02	0.00E+00	n/a	n/a	1.96E-02
Exported energy	MJ	0.00E+00	0.00E+00	n/a	n/a	0.00E+00

6 | LCA: Interpretation

Relative contributions of different life cycle stages to the total environmental impacts per 1 m^2 of Spaceloft® (White/Grey) or A2

The production stage of the process dominates the environmental impacts. Transport from the USA production facility to the construction site in Europe contributes less than 2% towards the global warming potential associated with the product. The process is a net producer of ethanol and credits for this production are taken into account where appropriate.

7 | Requisite evidence

Formaldehyde and VOC emissions

Measuring agency: Finnish institute of occupational health

Test report, date: Report number 120820, 1st December 2009.

VOC emissions

Name	Value	Unit
Overview of results (28 days)	0	µg/m^3
TVOC (C6-C16)	0	µg/m^3
Sum SVOC (C16-C22)	0	µg/m^3
R (dimensionless)	0	-
VOC without NIK	0	µg/m^3
Carcinogenic substances	0	µg/m^3

8 | References

PCR
The International EPD® System PCR 2012:01 version 1.2 for Construction Products and CPC 54 construction services.
The International EPD® System PCR 2014:13 Version 1.0 for Product Group: Multiple UN CPC Codes, Insulation Materials.

EN826:2013
Thermal insulating products for building applications – Determination of compressive behaviour.

EN 12086:2013
Thermal insulating products for building applications – Determination of water vapour transmission properties.

EN 12667:2001
Thermal performance of building materials and products – Determination of thermal resistance by means of guarded hot plate and heat flow meter methods – Products of high and medium thermal resistance.

EN 13501-1:2007 + A1:2009
Fire classification of construction products and building elements – Part 1: Classification using data from reaction to fire tests.

EN 15804:2012 + A1 2013
Sustainability of construction works – Environmental Product Declarations – Core rules for the product category of construction products.

ISO 9001:2008
Quality management systems.

ISO 14001:2004
Environmental management systems.

ISO 14020:2001
Environmental labels and declarations – General principles

ISO 14025:2011
Environmental labels and declarations – Type III environmental declarations – Principles and procedures.

EN 14040:2006
Environmental management – Life cycle assessment – Principles and framework.

EN 14044:2006
Environmental management – Life cycle assessment – Requirements and guidelines.

ISO 21930:2007
Sustainability in building construction – Environmental declaration of building products.

The International EPD System (2013). General Programme Instructions for the International EPD® System. Version 2.01, dated 2013-09-18.