

ENVIRONMENTAL PRODUCT DECLARATION

FELTWORKS®

ACOUSTICAL PANELS



FeltWorks® Acoustical Panels in White; Gensler Charlotte, Charlotte, NC

FeltWorks® Acoustical Panels offer a soft visual and excellent noise control with versatile installation options for design flexibility.



CEILING & WALL SOLUTIONS

COMMITTED TO SUSTAINABILITY

Armstrong World Industries leads in delivering solutions that meet today's most stringent industry sustainability standards. We are committed to environmental responsibility in all aspects of our business, and carbon reduction is part of our 2030 Company goals and ambitions.

We were one of the first companies to create and publish the Environmental Product Declaration (EPD) in the ceiling industry. We have over a decade of experience using Life Cycle Assessment (LCA) to evaluate environmental impacts of our products starting with design, to raw materials, and through our operations. We are constantly working to optimize our operations and products to reduce their environmental impact. We believe the use of LCA and our commitment to transparency of our products' carbon footprint is critical to contributing to decarbonization of the built environment.

Contents:

- Performance features like acoustics, light reflectance, and durability
- Product application and use
- Product ingredients and their sources
- How the product is produced
- LCA results, including global warming potential and primary energy usage
- Total impacts over the product life cycle

For more information visit armstrongceilings.com/transparency




ENVIRONMENTAL PRODUCT DECLARATION



FELTWORKS®
ACOUSTICAL PANELS

According to ISO 14025

1. CONTENT OF THE EPD

EPD PROGRAM AND PROGRAM OPERATOR NAME, ADDRESS, LOGO, AND WEBSITE	UL Environment https://www.ul.com 333 Pfingsten Road Northbrook, IL 60611 https://spot.ul.com
GENERAL PROGRAM INSTRUCTIONS AND VERSION NUMBER	General Program Instructions v.2.5 March 2020
MANUFACTURER NAME AND ADDRESS	Armstrong World Industries 2500 Columbia Avenue Lancaster, PA 17603
DECLARATION NUMBER (Part A and B)	4789756873.101.1
DECLARED PRODUCT & FUNCTIONAL UNIT OR DECLARED UNIT	0.093m ² (1ft ²)
REFERENCE PCR AND VERSION NUMBER	UL Environment PCR for Building-Related Products & Services – Part A (Dec. 2018, v.3.2), UL Environment PCR Part B: Non-Metal Ceiling Panel & Wall Panel System (April 2021, v.2.0)
DESCRIPTION OF PRODUCT'S INTENDED APPLICATION AND USE (AS IDENTIFIED WHEN DETERMINING PRODUCT RSL)	FeltWorks® Acoustical Panels
PRODUCT RSL DESCRIPTION (IF APPL.)	30 Years
MARKETS OF APPLICABILITY	Commercial and Residential Interior Furnishing
DATE OF ISSUE	October 1, 2021
PERIOD OF VALIDITY	5 Years
EPD TYPE	product-specific
DATASET VARIABILITY	–
EPD SCOPE	Cradle to Grave
YEAR(S) OF REPORTED MANUFACTURER PRIMARY DATA	2020
LCA SOFTWARE & VERSION NUMBER	GaBi 9 by Sphera Inc
LCI DATABASE(S) & VERSION NUMBER	GaBi Service Pack 39 by Sphera Inc
LCIA METHODOLOGY & VERSION NUMBER	TRACI 2.1
The sub-category PCR review was conducted by:	EPD Review Panel Chair: Dr Lindita Bushi epd@ul.com
This declaration was independently verified in accordance with ISO 14025: 2006. The UL Environment “Part A: Calculation Rules for the Life Cycle Assessment and Requirements on the Project Report,” serves as the core PCR.	
<input type="checkbox"/> INTERNAL <input checked="" type="checkbox"/> EXTERNAL	Thomas Gloria, Industrial Ecology Consultants
This life cycle assessment was conducted in accordance with ISO 14044 and the reference PCR by:	Sphera
This life cycle assessment was independently verified in accordance with ISO 14044 and the reference PCR by:	Thomas Gloria, Industrial Ecology Consultants
LIMITATIONS	
<p>Environmental declarations from different programs (ISO 14025) may not be comparable.</p> <p>Comparison of the environmental performance of Metal Ceiling and Wall System Products using EPD information shall be based on the product's use and impacts at the building level, and therefore EPDs may not be used for comparability purposes when not considering the building energy use phase as instructed under this PCR.</p> <p>Full conformance with this PCR allows EPD comparability only when all stages of a life cycle have been considered. However, variations and deviations are possible. Example of variations: Different LCA software and background LCI datasets may lead to differences results for upstream or downstream of the life cycle stages declared.</p>	



ENVIRONMENTAL PRODUCT DECLARATION



FELTWORKS®
ACOUSTICAL PANELS

According to ISO 14025

2. GENERAL INFORMATION

2.1 DESCRIPTION OF ORGANIZATION

Armstrong World Industries, Inc. (AWI) is a leader in the design and manufacture of innovative commercial and residential ceiling, wall and suspension system solutions in the Americas. At home, at work, in healthcare facilities, classrooms, stores, or restaurants, Armstrong World Industries offers interior solutions that help to enhance comfort, save time, improve building efficiency and overall performance, and create beautiful spaces.

For more than 150 years, we have built our business on trust and integrity. It set us apart then, and it sets us apart now, along with our ability to collaborate with, and innovate, for the people we're here to serve – our customers, our shareholders, our communities, and our employees.

We are committed to developing new and sustainable ceiling solutions, with design and performance possibilities that make a positive difference in spaces where we live, work, learn, heal, and play.

2.2 PRODUCT DESCRIPTION

Armstrong® FeltWorks® Acoustical Panels are 1" thick non-woven layered and formed polyester felt (PET) fiber panels with color throughout. Panels are Class A fire performance.

Features:

- Quick and easy retrofit acoustical solution
- Excellent sound absorption – NRC up to 0.90
- FeltWorks® Acoustical Panels are part of the Sustain® portfolio and meet the most stringent industry sustainability standards today
- CleanAssure™ family of products – includes disinfectable panels, suspension systems, and trim
- Mold- and mildew-resistant surface
- No need to field-finish cut edges with color throughout panels
- Custom sizes available from 18" x 18" up to 54" x 120"
- No visible fasteners with adhesive or magnet installation options

2.2.1 Product Specific EPD

FeltWorks® Acoustical Panels are manufactured for Armstrong World Industries in South Korea. Armstrong World Industries has a robust internal Quality Assurance process that is based on industry-accepted best practices and is led by a team of quality professionals who have been certified by the American Society for Quality. The process involves several hundred different measures made throughout the manufacturing processes. In addition, our products are UL labeled for fire and acoustical performance – a process that involves strict oversight by Underwriters Laboratories. The Armstrong Ceilings acoustical laboratory is ISO 17025 certified and is accredited by the National Voluntary Laboratory Accreditation Program (NVLAP).



ENVIRONMENTAL PRODUCT DECLARATION



FELTWORKS® ACOUSTICAL PANELS

According to ISO 14025

2.2.2 Product Identification

FeltWorks® Acoustical Panels are non-woven layered and formed polyester felt (PET) fiber panels with color throughout. This EPD includes FeltWorks Acoustical Panels, Blades, and Open Cell panels.

2.2.3 Product Specification

This EPD includes FeltWorks products. These products generally fall under ASTM E1264-98 Type XX as other recycled polymer felt fiber panels.

The modifications typically involve modifications to the thickness, shape, density, basemat composition and/or color pigmentation package.

This report covers the entire FeltWorks product line and focuses on highest volume product in the family. Other products within the family that differ by shape, size, and edge details of the panels are well represented within the scope of the study.



ENVIRONMENTAL PRODUCT DECLARATION

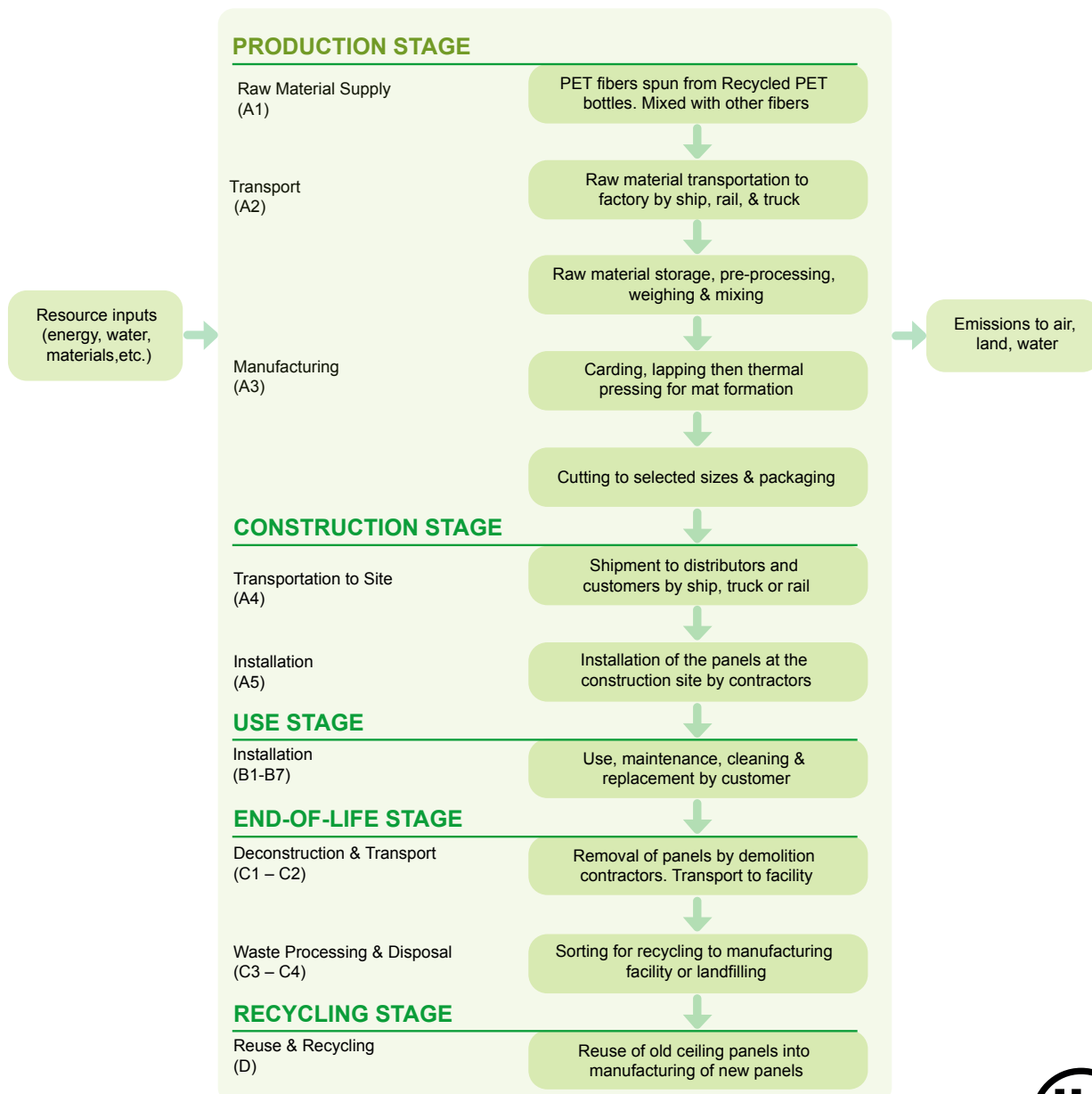


FELTWORKS® ACOUSTICAL PANELS

According to ISO 14025

2.2.4 Flow Diagram

Polyester nonwoven panel is a panel for thermal and acoustic insulation of walls and rooftops, manufactured with polyester fiber obtained by recycling PET bottles from differentiated waste collection. The upstream process involves extraction and production of raw materials for components and packaging; manufacturing of semifinished goods; manufacturing of additives (caustic soda, floating, surface-active, etc.); production processes for components and packaging; processing of post-consumer PET bottles, including collection, selection, and inbound transport; transport of post-consumer PET bottles from the selection plant to the factory; all auxiliary materials used in the process, as cleaning materials, chemical products, etc; the process of recycling of post-consumer PET bottles and spinning of fiber; manufacturing of virgin and recycled fiber coming from external suppliers; generation of electricity. Manufacturing processes of nonwoven material includes blending, carding, lapping, thermal bonding, formation of rolls or panels, and their storage. At the end of its useful life, the ceiling panel can then be preferably recycled or refurbished or sent to a landfill. Recycled ceilings can be returned to Armstrong World Industries as part of our recycling business process.



ENVIRONMENTAL PRODUCT DECLARATION



FELTWORKS® ACOUSTICAL PANELS

According to ISO 14025

2.3 PRODUCT AVERAGE

2.3.2 Product Specific EPD

In this specific case of FeltWorks Acoustical Panels product EPD manufacturing took place exclusively at a vendor's facility at Seoul Korea. Data collection for energy and other raw materials input stream was specific to this location and was supported by volume-driven mathematical modeling.

All primary data was collected at the facility using the internal manufacturing systems and databases that track inputs consumption.

2.4 APPLICATION

Commercial Interior Finish. Acoustical, Suspended Ceiling System. The ceiling system must be installed in accordance with Armstrong installation guidelines. For installation instructions visit armstrongceilings.com/feltworks

2.5 MATERIAL COMPOSITION

Major raw materials used in ceiling panel manufacturing are summarized in the table below.

Material	FeltWorks® Acoustical Panels
PET Polymer	98-100%
Fillers & Pigments	0-2%

2.6 TECHNICAL REQUIREMENTS

TABLE 1. TECHNICAL DATA

Name & Test Method	Value	Unit
Sound absorption coefficient (NRC) (ASTM C423)	0.75-0.90	NRC
Light reflectance (ASTM E1477)	0.78	n/a
Surface burning characteristics of building materials (ASTM E84, ASTM E1264)	Class A	Flame spread/ smoke developed

2.7 PROPERTIES OF DECLARED PRODUCT AS DELIVERED

The final EPD is available on the Armstrong website (armstrongceilings.com/epd); at UL SPOT (spot.ul.com) and is under the Finish category in the EC3 Tool (buildingtransparency.org).



ENVIRONMENTAL PRODUCT DECLARATION



FELTWORKS®
ACOUSTICAL PANELS

According to ISO 14025

3. METHODOLOGICAL FRAMEWORK

This study provides life cycle inventory and environmental impacts relevant to Armstrong® suspended ceilings. This LCA was conducted to 1) better understand the environmental impacts of the life cycle of suspended ceiling systems; 2) learn how the impacts of raw material selection, product formulation, and manufacturing process influence the life cycle impacts of suspended ceilings, and 3) use innovation to drive reduction in the product platform. The methods for conducting the life cycle assessments used for this project were consistent with ISO 14040 and 14044. This report is intended to fulfill the reporting requirements in Section 5 of ISO 14044 and Product Category Rules Guidance for Building-Related Products and Services UL® Environments (2021) Part B: Non-Metal Ceiling Panel EPD Requirements.

3.1 FUNCTIONAL UNIT

The declaration refers to the functional unit of 0.093 m² (1 ft²) of installed ceiling panel, as defined by the PCR.

3.2 DECLARED UNIT

The declaration refers to the declared unit of 0.093 m² (1 ft²) of installed ceiling panel, as defined by the PCR.

3.3 FUNCTIONAL/DECLARED UNIT PROPERTIES

TABLE 2. FUNCTIONAL OR DECLARED UNIT PROPERTIES

Name	Value	Unit
Functional unit	1	0.093m ² (1ft ²)
Declared unit (wall, ceiling, and column panels, covers, and assemblies)	1	0.093m ² (1ft ²)
Declared thickness	2.54	cm
Surface weight per declared unit	2.44	kg/m ²
Density per declared unit	96.1	kg/m ³

3.4 SYSTEM BOUNDARY

The scope of the study includes production, installation, use, end of life, and benefits and loads beyond the product system boundary. Production of capital equipment, facilities, and infrastructure required for manufacture are outside the scope of this assessment. Details of inclusions and exclusions from the system boundary are listed below.

THE CRADLE-TO-GRAVE ASSESSMENT INCLUDES:

- Raw material acquisition and processing for both the product and its packaging (A1)
- Inbound transport of raw materials to production facility (A2)
- Manufacturing energy of ceiling panels (A3)
- Energy production (A3)
- Manufacturing waste disposal (A3)
- Packaging of final products (A3)
- Outbound transport of products to job site (A4)
- Installation and installation waste (A5)
- Use stage considered, but no impact (B1-B7)
- End of life, including transport, deconstruction, waste processing, and disposal (C1-C4)
- Benefits and loads beyond the system boundary (D)



ENVIRONMENTAL PRODUCT DECLARATION



FELTWORKS® ACOUSTICAL PANELS

According to ISO 14025

THE CRADLE-TO-GRAVE ASSESSMENT EXCLUDES:

- Overhead facility energy (heating, lighting, etc.) of manufacturing facilities (A3)
- Construction of capital equipment and other infrastructure flows
- Maintenance and operation of support equipment
- Human labor and employee transport
- Manufacture and transport of packaging materials not associated with final product

3.5 PRODUCT SPECIFIC CALCULATIONS FOR USE PHASE (MODULES B1-B7)

Use (B1) of the ceiling panel does not require any activities that would contribute to potential environmental impacts of the product. Armstrong ceiling panels are manufactured using no added formaldehyde coatings. The VOC emissions during the use phase are negligible and the product complies with the Office and Classroom VOC Requirements of CDPH.

The ceiling panels do not require maintenance, (B2) repair (B3), replacement (B4), or refurbishment (B5) as part of regular use. Typically, panels are only replaced due to damage from leaking water or if the owner chooses to change them based on design requirements rather than performance concerns. The rate of replacement due to water leaks is minimal and there is currently no published data to help define this. It is believed to be minimal, with negligible effect on the overall potential environmental impacts of the ceiling panel. There is also no operation energy (B6) or water (B7) use for the installed ceiling panels.

3.6 PRODUCT SPECIFIC CALCULATIONS FOR END-OF-LIFE PHASE (MODULES C1-C4)

At this time, there is no industry consensus for product-specific assumption behind reported scenarios for information in modules C1-C4. Armstrong facilitates ceiling panels recycling through our Takeback program. The recovery data is based on internal averages for commingled ceiling panels that arrived at Armstrong factories from the construction and demolition site at end of product life. Remaining panels were assumed to be landfilled as per standard industry practice.

3.7 REFERENCE SERVICE LIFE AND ESTIMATED BUILDING SERVICE LIFE

The Reference Service Life (RSL) was indicated according to Part A, Section No 2.8.2 in this document. The RSL was assumed to be 30 years for both ceiling and wall panel systems. Similarly the Estimated Building Life (ESL) was assumed to be 75 years for this study.

The assumptions upon which the designated RSL is based, and for which the RSL exclusively applies, shall be provided in Section 4.

3.8 ALLOCATION

No co-product or by-product allocation was necessary during manufacturing, use, or end of life. Allocation of background data (energy and materials) taken from the GaBi databases. In the case of secondary raw materials (i.e., recycled paper), only burdens from the point of recovery forward were considered (cut-off approach). The primary production of recycled materials was outside the system boundary.

3.9 CUT-OFF RULES

No cut-off rules are defined for 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.



ENVIRONMENTAL PRODUCT DECLARATION



FELTWORKS®
ACOUSTICAL PANELS

According to ISO 14025

3.10 DATA SOURCES

The GaBi LCI database provides the life cycle inventory data for the background system. Documentation for all generic datasets can be found at gabi-software.com/america/support/gabi/. National and regional averages for fuel inputs, electricity grid mixes, and process water were obtained from the GaBi database. Data for up- and downstream raw materials and unit processes were obtained from the GaBi database. Data for fiberglass board, adhesive and scrim were obtained from our supplier Owens Corning. Transport processes for the basic material, i.e. the delivery to Armstrong, and the transport for the disposal of production waste are integrated in module A1-A3. The environmental burdens of transport of the packaged product, i.e. from the production site to the construction site (U.S. average) are assigned to module A4. Emission data for all upstream materials, electricity, and energy carriers were obtained from the GaBi database. The emissions (CO₂, NO_x, SO₂, etc.) due to the use of electricity and combustion of fuels are accounted for with the use of the LCI processes.

Emissions associated with transportation were determined by capturing the average transportation distances and modes for inbound raw materials, distribution to installation, and end-of-life disposal. Energy use and the associated emissions were calculated using pre-configured transportation models from the GaBi database.

3.11 DATA QUALITY

Inventory data quality is judged by its precision (measured, calculated, or estimated), completeness (e.g., unreported emissions), consistency (degree of uniformity of the methodology applied on a study serving as a data source), and representativeness (geographical, temporal, and technological).

To cover these requirements and to ensure reliable results, first-hand industry data in combination with literature and background LCA information from the GaBi database were used. The LCI data sets from the GaBi database are widely distributed and used with the GaBi software. The datasets have been used in LCA models worldwide in industrial and scientific applications in internal as well as in many critically reviewed studies. In the process of providing these datasets they are cross-checked with other databases and values from industry and science.

3.12 PERIOD UNDER REVIEW

All the primary data in the scope of this analysis was collected from Armstrong manufacturing facilities during 2020.

3.13 COMPARABILITY AND BENCHMARKING

FeltWorks® Acoustical Panels offer unique set of product attributes and we do not have any data on comparable non-competitive products to report.

3.14 ESTIMATES AND ASSUMPTIONS

There are no specific assumptions to list that are not dealt with in the appropriate section. When an assumption is made it will be described within the specific stage of the report. As an example a 7% waste factor was utilized for the waste generated during the installation of the product. This is described in more detail within the installation section of the report

TABLE 3. TRANSPORT, INSTALLATION, AND DECONSTRUCTION PROCEDURES

Product transport from point of manufacture to building site	Mode: Diesel-powered truck/trailer Distance: 800 km
Product transport from building site to waste processing	Mode: Diesel-powered truck/trailer Distance: 35 km
Installation & deconstruction procedures	Manual (no operational energy use)

3.15 UNITS

Units commonly used in the North American market are included in addition to the required SI units.



ENVIRONMENTAL PRODUCT DECLARATION



FELTWORKS®
ACOUSTICAL PANELS

According to ISO 14025

4. TECHNICAL INFORMATION AND SCENARIOS

All data is reported as a North American weighted average across our ceiling plant locations. The majority of Armstrong® Ceiling products are distributed within 500 miles of the respective manufacturing plants. The same distribution trucks that take material to distribution centers backhaul post-consumer recycled ceiling panels to the manufacturing plants as part of our closed loop recycling program. If product is not recycled, disposal transportation at end of life is assumed to be 50 miles. Transportation emissions and fuels throughout the life cycle phases are included. All transportation associated with raw materials reflect the actual modes of transportation and mileage.

AWI Facilities



4.1 MANUFACTURING

The manufacturing process has been described in a simple flow chart in Section 2.2.4. When a product is manufactured at multiple locations, a volume-based averaging of the input parameters approach was used. Armstrong has a comprehensive environmental, health, and safety management program. Risk reduction begins in the product design process. All products go through a safety, health, and environmental review prior to sale. Armstrong also has a long standing commitment to the safety and health of all our employees. The company's safety management program is considered to be World Class. Our OSHA recordable incident rate is below 1.0, meaning that there is less than one injury per 100 employees per year. All employees view safety as a key responsibility of their jobs.

Armstrong World Industries is equally committed to reducing our environmental impact. As with safety goals, each manufacturing facility has environmental initiatives focused on responsible use of energy and water, and on waste reduction. Any manufacturing waste was reported in the primary data for this study.

4.2 PACKAGING

The product is packaged using cardboard boxes and Kraft paper, loaded onto pallets and wrapped with plastic film to prepare for shipment.



ENVIRONMENTAL PRODUCT DECLARATION



FELTWORKS®
ACOUSTICAL PANELS

According to ISO 14025

4.3 TRANSPORTATION

The products are transported from the manufacturing site in South Korea to the distribution center in the US by container ship, and then to the construction site by truck. Further detail on transportation assumptions is presented in Table 4.

TABLE 4. TRANSPORT TO THE BUILDING SITE (A4)

Name	Value	Unit
Fuel type	Diesel	
Liters of fuel	3.41E+03	L/100km
Vehicle type	Truck	
Transport distance	2.50E+02	km
Capacity utilization	67	%
Gross density of products transported	96.1	kg/m ³
Weight of products transported	-	kg
Volume of products transported	-	m ³
Capacity utilization volume factor packaging products	0.87	

4.4 PRODUCT INSTALLATION

The ceiling system must be installed in accordance with Armstrong Ceilings installation guidelines. Our ceiling system installation brochure, "Installing Suspended Ceilings", is a general application overview, covering essential steps of a basic suspended ceiling installation. You can reference this document at armstrongceilings.com/feltworks

The product is installed by directly attaching to the deck using the factory cut sizes. The installation of this product is not wall to wall and therefore these panels do not need any cutting or trimming at job site. This significantly minimizes any waste generation at the job site and therefore based on our observations of various job sites we are using 1% waste factor in the scope of this LCA study.

TABLE 5. INSTALLATION INTO THE BUILDING (A5)

Name	Value	Unit %
Ancillary materials	0	kg
Net freshwater consumption specified by water source and fate	0	m ³
Other resources	0	kg
Electricity consumption	0	kWh
Other energy carriers	0	MJ
Product loss per functional unit	-	kg
Waste materials at the construction site before waste processing, generated by product installation	1.59E-02	kg
Output materials resulting from on-site waste processing	-	kg
Mass of packaging waste specified by type	-	kg
Biogenic carbon contained in packaging	-	kg CO ₂
Direct emissions to ambient air, soil and water	-	kg
VOC emissions	Negligible	µg/m ³



ENVIRONMENTAL PRODUCT DECLARATION



FELTWORKS® ACOUSTICAL PANELS

According to ISO 14025

4.5 USE

As per the PCR it was assumed that no energy, material, and water inputs were needed during the use phase of the ceiling panel system under recommended normal operating conditions. Consideration of any resources used during maintenance and repairs during normal use of ceiling system were outside the scope of this study.

Maintenance (B2), Repair (B3), Replacement (B4) , Refurbishment (B5)

Non-metal ceiling and wall panels were assumed to not need repainting, maintenance, or repairing, and to last the entire duration of the building ESL with no replacement or refurbishment.

Reference Service Life

A product's RSL depends on the product properties and reference in-use conditions. The default RSL assumed in this PCR is 30 years for both ceiling and wall products.

4.6 DISPOSAL

End of Life

The end-of-life phase for the ceiling panels was included in the study. End-of-life impacts include disposal of ceiling panels, scap, and packaging at the end of installation. Armstrong World Industries offers a ceiling recycling program as a closed loop end-of-life solution instead of landfill or alternative disposal methods. Although the ceiling recycling is a successful program, the volume does vary from year to year so a conservative approach was taken within the study to not include the recycle program but to rather consider that all panels are landfilled or incinerated. The study was also conservative in the fact that it did not take credit for any energy that was recovered in the landfill process.

TABLE 6. END OF LIFE (C1-C4)

Name		Value	Unit
Assumptions for scenario development (description of deconstruction, collection, recovery, disposal method, and transportation)			
Collection process (specified by type)	Collected separately	0	kg
	Collected with mixed construction waste	0	kg
Recovery (specified by type)	Reuse	0	kg
	Recycling	2.27E-03	kg
	Incineration	0	kg
	Incineration with energy recovery	0	kg
	Energy conversion (specify efficiency rate)	-	
Disposal (specified by type)	Product or material for final disposal	-	kg
Removals of biogenic carbon (excluding packaging)		0	kg CO ₂



ENVIRONMENTAL PRODUCT DECLARATION



FELTWORKS®
ACOUSTICAL PANELS

According to ISO 14025

4.7 REUSE PHASE

TABLE 7. REUSE, RECOVERY, AND/OR RECYCLING POTENTIALS (D), RELEVANT SCENARIO INFORMATION

Name	Value	Unit
Net energy benefit from energy recovery from waste treatment declared as exported energy in C3 (R>0.6)	0	MJ
Net energy benefit from thermal energy due to treatment of waste declared as exported energy in C4 (R<0.6)	0	MJ
Net energy benefit from material flow declared in C3 for energy recovery	0	MJ
Process and conversion efficiencies	-	
Further assumptions for scenario development	-	



ENVIRONMENTAL PRODUCT DECLARATION



FELTWORKS®
ACOUSTICAL PANELS

According to ISO 14025

5. ENVIRONMENTAL INDICATORS DERIVED FROM LCA

5.1 LCA RESULTS FROM LCIA

The Life Cycle Assessment (LCA) was performed according to ISO 14040 guidelines and follows the specific PCR instructions. The cradle-to-grave LCA consists of raw material production, transport of raw materials to production facility prior to processing, manufacturing of ceiling panels, packaging; transportation to job site and installation, use phase, and end of life including disposal or recycling to Armstrong factories.

TABLE 8. DESCRIPTION OF THE SYSTEM BOUNDARY MODULES

EPD Type	Production			Construction		Use							End Of Life				Benefits And Loads Beyond System Boundary			
	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D			
	Raw material supply	Transport	Manufacturing	Transport to site	Assembly/Install	Use	Maintenance	Repair	Replacement	Refurbishment	Operational Energy Use	Operational Water Use	Deconstruction	Transport	Waste processing	Disposal	Reuse, Recovery, Recycling Potential	Reference Service Life		
Cradle-to-gate with EOL	Required			Excluded							Required, Depending on Part A, Section 2.8.4.5				Optional	Optional				
Cradle-to-gate with Options	Required			Optional	Optional							Required, Depending on Part A, Section 2.8.4.5				Optional	Optional			
Cradle-to-grave	Required																		Optional	Required
Declared Modules (Indicated with an X)	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	



ENVIRONMENTAL PRODUCT DECLARATION



FELTWORKS®
ACOUSTICAL PANELS

According to ISO 14025

5.2 LCA RESULTS FROM LCI

Life cycle impacts reported below are based on TRACI 2.1 methodology. All the results are provided in reference to the declared unit, and for convenience of the reader we have included additional grouping across the system boundaries and provided conversion in SI unit. For the other impact categories, results are presented in the tables below using the EN15804 standard and for the declared unit. Also for readers convenience conversions are provided in each table to SI units.

TABLE 9. TRACI 2.1 IMPACT ASSESSMENT

Parameter	Parameter	Unit	A1 - A3	A4 - A5	B1 - B7	C1 - C4	D	Total 0.093m ² (1ft ²)
GWP, total	Global warming potential	kg CO ₂ - Eq.	1.69E-01	6.94E-02	0.00E+00	5.70E-02	1.42E-03	3.19E+00 (2.96E-01)
GWP fossil	Global warming potential	kg CO ₂ - Eq.	2.21E-01	6.91E-02	0.00E+00	5.70E-02	-4.12E-04	3.74E+00 (3.47E-01)
ODP	Stratospheric ozone layer depletion	kg CFC - 11 Eq.	3.18E-13	2.70E-15	0.00E+00	-4.01E-16	6.78E-15	3.52E-12 (3.27E-13)
AP	Acidification potential	kg SO ₂ - Eq.	3.90E-04	1.81E-03	0.00E+00	7.56E-05	-3.38E-06	2.45E-02 (2.28E-03)
EP	Eutrophication potential	kg N - Eq.	3.15E-05	6.68E-05	0.00E+00	5.71E-06	-6.40E-07	1.11E-03 (1.03E-04)
POCP	Photochemical ozone creation potential	kg O ₃ - Eq.	3.20E-05	8.91E-05	0.00E+00	4.19E-06	-4.75E-07	1.34E-03 (1.25E-04)
ADP	Abiotic resource depletion potential – fossil fuels	MJ	2.41E+00	8.71E-01	0.00E+00	2.79E-01	-1.23E-02	3.82E+01 (3.55E+00)

5.3 LCA RESULTS FROM LCI

TABLE 10. LCA RESULTS - RESOURCE USE

Parameter	Description	Unit	Total 0.093m ² (1ft ²)
PERE	Renewable primary energy as energy carrier	MJ, LHV	5.87E+00 (5.46E-01)
PERM	Renewable primary energy resources as material utilization	MJ, LHV	0.00E+00 (0.00E+00)
PERT	Total use of renewable primary energy resources	MJ, LHV	5.87E+00 (5.46E-01)
PENRE	Non-renewable primary energy as energy carrier	MJ, LHV	4.72E+01 (4.39E+00)
PENRM	Non-renewable primary energy as material utilization	MJ, LHV	0.00E+00 (0.00E+00)
PENRT	Total use of non-renewable primary energy resources	MJ, LHV	4.72E+01 (4.39E+00)
SM	Use of secondary material	kg	2.34E+00 (2.17E-01)
RSF	Use of renewable secondary fuels	MJ, LHV	0.00E+00 (0.00E+00)
NRSF	Use of non-renewable secondary fuels	MJ, LHV	0.00E+00 (0.00E+00)
FW	Use of net fresh water	m ³	1.14E-02 (1.06E-03)



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ACOUSTICAL PANELS

According to ISO 14025

TABLE 11. LCA RESULTS: OUTPUT FLOWS AND WASTE CATEGORIES

Parameter	Description	Unit	Total 0.093m ² (1ft ²)
HWD	Hazardous waste disposed	kg	0.00E+00 (0.00E+00)
NHWD	Non-hazardous waste disposed	kg	6.70E-01 (6.22E-02)
HLRW	Radioactive waste disposed	kg	-5.28E-06 (-4.90E-07)
ILLRW	Intermediate & Low Level Radioactive Waste	kg	-3.89E-03 (-3.61E-04)
CRU	Components for reuse	kg	0.00E+00 (0.00E+00)
MFR	Materials for recycling	kg	2.33E+00 (2.16E-01)
MER	Materials for energy recovery	kg	0.00E+00 (0.00E+00)
EEE	Exported energy	MJ, LHV	2.22E-02 (2.06E-03)

TABLE 12. CARBON EMISSIONS AND REMOVALS DESCRIPTION

Parameter	Description	Unit	Total 0.093m ² (1ft ²)
BCRP	Biogenic Carbon Removal from Product	kg CO ₂	0.00E+00 (0.00E+00)
BCEP	Biogenic Carbon Emission from Product	kg CO ₂	0.00E+00 (0.00E+00)
BCRK	Biogenic Carbon Removal from Packaging	kg CO ₂	8.70E-01 (8.09E-02)
BCEK	Biogenic Carbon Emission from Packaging	kg CO ₂	6.48E-01 (6.02E-02)



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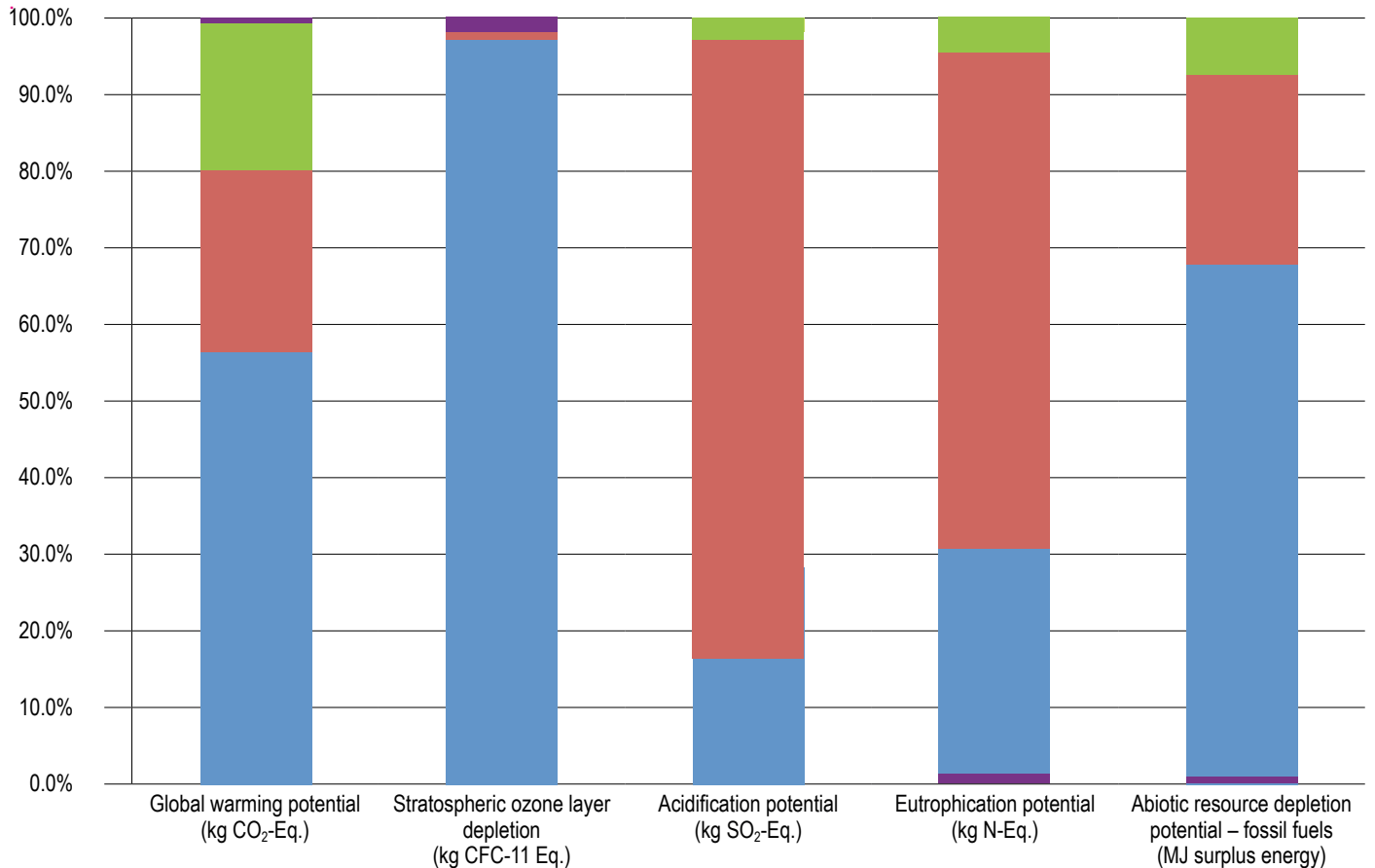


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6. LCA: INTERPRETATION

From the 2020LCA Model of the ceiling life cycle covered in this study, it was concluded that the ceiling panel manufacturing process and raw materials in the ceiling panel – have the greatest impact on “carbon footprint” as represented by Global Warming Potential [GWP].



KEY

- Production ■
- Construction ■
- End of Life ■
- Recycle ■

Life Cycle Impact Assessment of FeltWorks® Acoustical Panels^{1,2} relative importance in percentage terms for the Production, Use, and End-of-Life stages for the ceiling panel.

¹ Based on U.S. EPA TRACI 2.1 Impact Factors

² Data is from FeltWorks 1" Square Lay-In items



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7. ADDITIONAL ENVIRONMENTAL INFORMATION

7.1 ENVIRONMENT AND HEALTH DURING MANUFACTURING

Armstrong World Industries has a comprehensive environmental, health, and safety management program. Risk reduction begins in the product design process. All products go through a safety, health, and environmental review prior to sale. Armstrong also has a long-standing commitment to the safety and health of all our employees.

Armstrong World Industries is equally committed to reducing our environmental impact. As with safety goals, each manufacturing facility has environmental initiatives focused on responsible use of energy and water, and on waste reduction.

7.2 ENVIRONMENT AND HEALTH DURING INSTALLATION

All recommendations shall be utilized as indicated by SDS and installation guidelines. Specific product SDS and installation instructions can be downloaded at: armstrongceilings.com/pdbupimages-clg/217521.pdf

7.3 EXTRAORDINARY EFFECTS

Fire Performance

Each color has its own test report per ASTM E84. Flame Spread Index 25 or less. Smoke Developed Index 1" FeltWorks® panel tested according to CAN/ULC S102.2-10. Flame Spread value 50. Smoke Developed Classification I/c p 140. 450 or less. Class A.

Water/Sag Resistance

HumiGuard® Plus panels offer superior resistance to sagging in high humidity conditions up to, but not including, standing water and outdoor applications and carries a 30-year limited system warranty.

Seismic Performance

Seismic Categories C, D, E, and F

ICC-ES ESR-1308 – see armstrongceilings.com/seismicrx

Acoustical Panel Classification

ASTM E1264-98 Type XX Pattern Z

Other, Fire Class A

Mechanical Destruction – Not applicable to ceiling products

7.4 DELAYED EMISSIONS

Delayed emissions were not considered in this study.



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FELTWORKS®
ACOUSTICAL PANELS

According to ISO 14025

7.5 ENVIRONMENTAL ACTIVITIES AND CERTIFICATIONS

All environmental certifications can be found at: Armstrongceilings.com

FeltWorks: armstrongceilings.com/commercial/en/commercial-ceilings-walls/ceilings/feltworks-ceiling-family.html

Transparency Documents: armstrongceilings.com/commercial/en-us/performance/sustainable-building-design/transparency-documents.html

Technical Downloads & Resources: armstrongceilings.com/commercial/en-us/technical-downloads.html

7.6 FURTHER INFORMATION

Additional Information can be found at: armstrongceilings.com Specific product SDS and installation instructions can be downloaded at: armstrongceilings.com/pdbupimages-clg/217521.pdf

8. PROJECT REPORT AND SUPPORTING DOCUMENTATION

This study provides life cycle inventory and environmental impacts relevant to Armstrong® suspended ceilings. This LCA was conducted to 1) better understand the environmental impacts of the life cycle of suspended ceiling systems; 2) learn how the impacts of raw material selection, product formulation, and manufacturing process influence the life cycle impacts of suspended ceilings, and 3) use innovation to drive reduction in the product platform. The methods for conducting the life cycle assessments used for this project were consistent with ISO 14040 and 14044. This report is intended to fulfill the reporting requirements in Section 5 of ISO 14044 and Product Category Rules Guidance for Building-Related Products and Services UL® Environments (2021) Part B: Non-Metal Ceiling Panel EPD Requirements.

Armstrong World Industries has a robust internal Quality Assurance process that is based on industry-accepted best practices and is led by a team of quality professionals who have been certified by the American Society for Quality. The process involves several hundred different measures made throughout the manufacturing processes. In addition, our products are UL® labeled for fire and acoustical performance – a process which involves strict oversight by Underwriters Laboratories. The Armstrong Ceilings acoustical laboratory is ISO 17025 certified and is accredited by the National Voluntary Laboratory Accreditation Program (NVLAP).

9. REFERENCES

SUSTAINABILITY REPORTING STANDARDS

ISO 14025:2006 – Environmental – Principles and procedures

ISO 14040:2006/AMD 1:2020 – Environmental management – Life cycle assessment – Principles and framework

ISO 14044:2006/AMD 1:2017 AMD 2:2020 – Environmental management – Life cycle assessment – Requirements and guidelines

ISO 14046:2014 – Environmental management – Water footprint – Principles, requirements and guidelines.

ISO 15392:2019 – Sustainability in building construction – General principles

ISO 15686-1:2011 – Buildings and constructed assets – Service life planning- Part 1: General principles

ISO 15686-2:2012 – Buildings and constructed assets – Service life planning Part 2: Service life prediction procedures

ISO 15686-7:2017 – Buildings and constructed assets – Service life planning Part 7: Performance evaluation for feedback of service life data from practice

ISO 15686-8:2008 – Buildings and constructed assets – Service life planning Part 8: Reference service life and service life estimation

UL PCR Part B:2021 – Non-metal ceilings and interior walls panels



ENVIRONMENTAL PRODUCT DECLARATION



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According to ISO 14025

TESTING AND CLASSIFICATION

ISO/IEC 17025:2017 – General Requirements for the Competence of Testing and Calibration Laboratories

American Conference of Governmental Industrial Hygienists (ACGIH®) Threshold Limit Values and Biological Exposure Indices

Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources using Environmental Chambers version 1.2, January 2017.

ASTM C423 – Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method

ASTM C636 – Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustic Panel and Lay-in Panels

ASTM E84 – Test Method for Surface Burning Characteristics of Building Materials

ASTM E1110 – Standard Classification for Determination of Articulation Class

ASTM E1111 – Standard Test Method for Measuring the Interzone Attenuation of Open Office Components

ASTM E1264 – Standard Classification for Acoustical Ceiling Products

ASTM E1414 – Standard Test Method for Airborne Sound Attenuation Between Rooms Sharing a Common Ceiling Plenum

ASTM E1477 – Standard Test Method for Luminous Reflectance Factor of Acoustical Materials by Use of Integrating-Sphere Reflectometers

ASTM E413 – Classification for Rating Sound Insulation

ANSI/UL 1784-2015 – Air Leakage Test of Door Assemblies

RELEVANT FEDERAL STANDARDS AND SOPs

Environment Canada, National Pollutant Release Inventory (NPRI) (<http://www.ec.gc.ca/inrp-npri/>)

EPCRA 313 Toxic Release Inventory Reporting (US) (<http://www2.epa.gov/toxics-release-inventory-tri-program>)

U.S. EPA, ORD/NRMRL/Sustainable Technology Division, Systems Analysis Branch, SOP No. S-10637-OP-1-0- Tool for the Reduction and Assessment of Chemical and other Environmental Impacts (TRACI), Software Name and Version Number: TRACI version 2.1, USER'S MANUAL, 24 July 2012

UP EPA. Advancing Sustainable Materials Management: 2014 Tables and Figures Assessing Trends in Material Generation, Recycling, Composting, Combustion with Energy Recovery and Landfilling in the US. December 2016. (https://www.epa.gov/sites/production/files/2016-11/documents/2014_smm_tablesfigures_508.pdf)

U.S.: Resource Conservation and Recovery Act (RCRA), Clause C (<https://www.epa.gov/rcra/resource-conservation-and-recovery-act-rcra-overview>)

40 CFR 50 Protection of Environment – Part 50: National Primary and Secondary Ambient Air Quality Standards (U.S.) (https://www.ecfr.gov/cgi-bin/text-idx?tpl=/ecfrbrowse/Title40/40cfr50_main_02.tpl)

Clean Air Act (CAA) Section 112(r): Accidental Release Prevention/Public Management Rule (https://www.epa.gov/sites/production/files/2020-03/documents/caa112_rmp_factsheet_march_2020_final.pdf)



ENVIRONMENTAL PRODUCT DECLARATION



FELTWORKS® ACOUSTICAL PANELS

According to ISO 14025

CERCLA Hazardous Substances (US)

(<https://www.epa.gov/epcra/consolidated-list-lists-under-epcracerclacaa-ss112r-june-2019-version>)

U.S. Department of Labor, Occupational Safety & Health Administration

(OSHA 1910.1200 Hazard Communication Standard—Toxic and Hazardous Substances (US)

(http://www.osha.gov/pls/oshaweb/owadis.show_document?p_table=standards&p_id=10099)

U.S. Federal Trade Commission, 16 CFR Part 260, Guides for the Use of Environmental Marketing Claims; Final Rule, VI. Free Of Claims.

(https://www.ftc.gov/sites/default/files/documents/federal_register_notices/guides-use-environmental-marketing-claims-green-guides/greenguidesfrn.pdf)

RELEVANT PCRs AND PCR GUIDANCE

ACLCA Guidance to Calculating Non-LCIA Inventory Metrics in Accordance with ISO 21930:2017. May 2019.

<https://aclca.org/wp-content/uploads/ISO-21930-Final.pdf>

ISO 21930:2017 – Sustainability in buildings and civil engineering works – Core rules for environmental product declarations of construction products and services

ISO 14027:2017 – Environmental labels and declarations – Development of product category rules

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

ISO 21930: 2017 – Sustainability in buildings and civil engineering works – Core rules for environmental product declarations of construction products and services

Part A: Life Cycle Assessment Calculation Rules and Report Requirements UL® Environment (December 2018, version 3.2)

USGBC and UL Environment. PCR Committee Process and Resources: Part B. July 2017

UL Environment PCR for Building-Related Products & Services – Part A (Dec. 2018, v.3.2),

UL Environment PCR Part B: Non-Metal Ceiling Panel & Wall Panel System (April 2021, v.2.0)

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