ENVIRONMENTAL PRODUCT DECLARATION

FeltWorks® Acoustical Panels

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Armstrong®
World Industries

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.

UL CERTIFIED
ENVIRONMENTAL PRODUCT DECLARATION
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ENVIRONMENTAL PRODUCT DECLARATION

FeltWorks® Acoustical Panels

According to ISO 14025, EN 15804 and ISO21930:2017

EPD PROGRAM AND PROGRAM OPERATOR NAME, ADDRESS, LOGO, AND WEBSITE	UL Environment 333 Pfingsten Road Northbrook, IL 60611 https://www.ul.com/ 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 Ave, Lancaster, PA 17603
DECLARATION NUMBER	4789406799.101.1
DECLARED PRODUCT & FUNCTIONAL UNIT OR DECLARED UNIT	1 m²
REFERENCE PCR AND VERSION NUMBER	Part B: Mechanical, Specialty, Thermal, and Acoustic Insulation Product EPD Requirements, UL 10010–03, version 1.0
DESCRIPTION OF PRODUCT APPLICATION/USE	FeltWorks® Acoustical Panels
PRODUCT RSL DESCRIPTION (IF APPL.)	75 years
MARKETS OF APPLICABILITY	North America
DATE OF ISSUE	January 15, 2021
PERIOD OF VALIDITY	5 years
EPD TYPE	Product-specific
RANGE OF DATASET VARIABILITY	N/A
EPD SCOPE	Cradle to grave with options (A1-3, A4 A5, C1, C2, C3, C4)
YEAR(S) OF REPORTED PRIMARY DATA	2019
LCA SOFTWARE & VERSION NUMBER	GaBi 8.5.0.79
LCI DATABASE(S) & VERSION NUMBER	GaBi Database 8007
LCIA METHODOLOGY & VERSION NUMBER	TRACI 2.1 v1.05; CML-IA version 4.2

The PCR review was conducted by:	PCR Review Panel
This declaration was independently verified in accordance with ISO 14025: 2006. ☐ INTERNAL ☒ EXTERNAL	Jessica Kwon, UL Environment
This life cycle assessment was independently verified in accordance with ISO 14044 and the reference PCR by:	Thomas Gloria, Industrial Ecology Consultants

LIMITATIONS

Exclusions: EPDs do not indicate that any environmental or social performance benchmarks are met, and there may be impacts that they do not encompass. LCAs do not typically address the site-specific environmental impacts of raw material extraction, nor are they meant to assess human health toxicity. EPDs can complement but cannot replace tools and certifications that are designed to address these impacts and/or set performance thresholds – e.g. Type 1 certifications, health assessments and declarations, environmental impact assessments, etc.

Accuracy of Results: EPDs regularly rely on estimations of impacts; the level of accuracy in estimation of effect differs for any particular product line and reported impact.

Comparability: EPDs from different programs may not be comparable. Full conformance with a 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.

1. Product Definition and Information

1.1. Description of Company/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 enhance, comfort, save time, improve building efficiency and overall performance, and create beautiful spaces.

1.2. Product Description

Product Identification

FeltWorks® Acoustical Panels are made from 100% polyester fiber, bonded using heat instead of chemical binders. Polyester is naturally resistant to moisture, insects and mold. And, it is lightweight, easy to work with, yet still highly durable.

Product Specification

For the declared product, the following technical data in the delivery status must be provided with reference to the test standards:

Table 1. Technical Specifications

PROPERTY	TEST METHOD	VALUE
Fire hazard classification	ASTM E84	Available in Class A
Noise reduction coefficient	ASTM C423 Mounting A	NRC 0.70 SAA 0.69
Fungi resistance of insulation materials and facings	ASTM C1338-08	Pass
Classification of reaction to fire	BS EN 13823:2010 BS EN ISO 11925-2:2010	Reaction to fire classification B-s1,d0

Product Average

The results of this declaration represent an average performance for the listed products and manufacturing locations. The average product is calculated based on the weight of production.

1.3. Application

FeltWorks® Acoustical Panels are used on interior ceilings and walls to provide outstanding sound absorption.

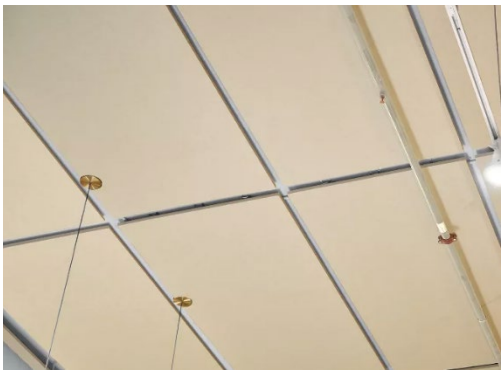
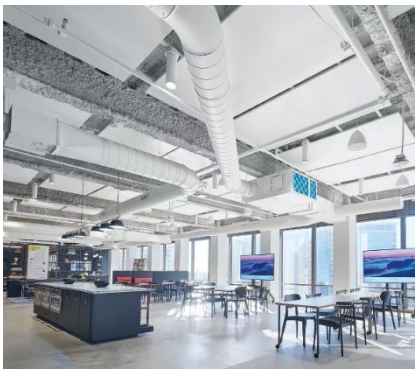
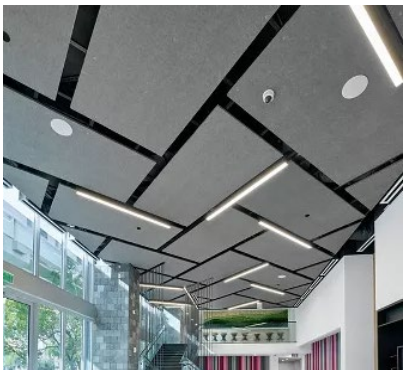




Figure1. FeltWorks® Acoustical Panels in its various application

1.4. Declaration of Methodological Framework

This declaration is a product-specific EPD and is cradle-to-installation with end-of-life. The underlying LCA upon which this EPD is based included the following life cycle modules: Raw Material supply (A1); Inbound Transportation (A2); Manufacturing (A3); Distribution (A4); Installation (A5); End-of-life, Deconstruction (C1); Transport (C2); Waste processing (C3) and End-of-life, Disposal (C4). No known flows have been deliberately excluded. The product is expected to perform as claimed for the 75-year reference service life if it remains clean and dry in its installed state.

1.5. Technical Requirements

The standards that can be applied for FeltWorks® Acoustical Panels are:

- ASTM E84 - Surface Burning Characteristics; pursuant to test certificate
- ASTM C423 - Sound Absorption
- ASTM C1338-08 – Fungi Resistance of Insulation Materials and Facings
- BS EN 13823:2010 / BS EN ISO 11925-2:2010 Reaction to fire classification B-s1,d0

1.6. Properties of Declared Product as Delivered

The declared product dimensions vary by installation. The range of products declared in the table below has a density of 80 to 120 kg/m^3, a thickness of 25 mm to 50 mm. Since the ranges are declared, variations may occur for specific products.

Table 2. Declared Unit Properties of FeltWorks® Acoustical Panels

NAME	VALUE	UNIT
Declared unit	1	㎡
Density	80 - 120	kg/㎥
Thickness	25 - 50	㎜

1.7. Material Composition

The composition of the FeltWorks Acoustical Panels (1㎡) is as follows:

Table 3. Material Composition

MATERIAL COMPONENT	QUANTITY (% BY MASS)
Polyester staple fiber	10 ~ 40
Polyester fiber	60 ~ 90
Other	<1

1.8. Manufacturing

Manufacturing Process

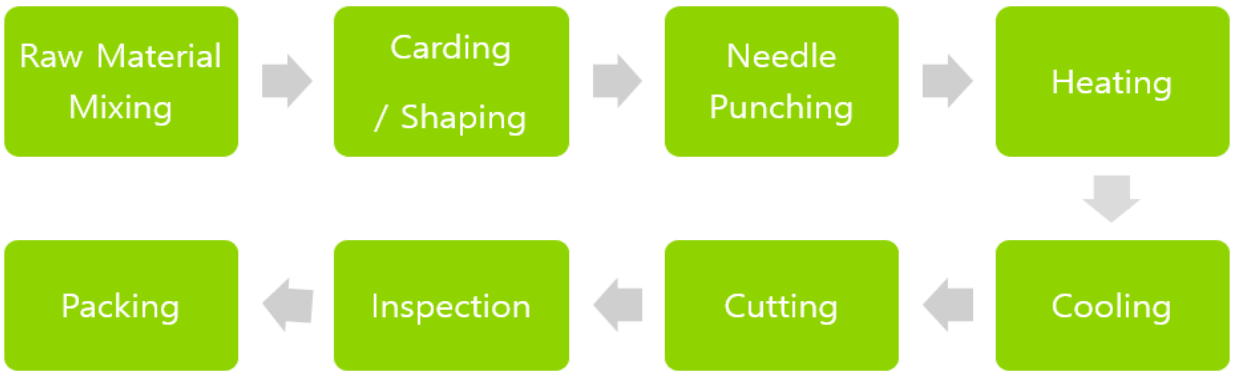


Figure2. FeltWorks Acoustical Panels Manufacturing Process

1.9. Packaging

FeltWorks Acoustical Panels are packaged using LDPE (low-density polyethylene) film in the form of bag or plastic film. The regional disposal scenarios for the U.S. is the default assumption for the packaging waste generated during installation. The disposal rates by material type and waste treatment method are shown in the table below.

Table 4. Disposal rates used by material type and waste treatment method

Country/Region	Material Type	Recycling Rate	Landfill Rate	Incineration Rate
United States	Plastics	15%	68%	17%
	Metals	57%	34%	9%
	Pulp(cardboard, paper)	75%	20%	5%

1.10. Transportation

The outbound transportation of the product from the manufacturing facility is diesel-truck and ship. The weighted average distance from the manufacturing site to the customer is 463 km by truck and 11,010 km by ship.

1.11. Product Installation

FeltWorks Acoustical Panels are made for easy handling and installation. Installation of FeltWorks panels is accomplished by manual labor using mostly hand tools. No material or energy inputs are required on the jobsite.

1.12. Use

There are no special features to be noted within the limits of normal and customary usage.

1.13. Reference Service Life and Estimated Building Service Life

The product is assumed to remain in service for the life of the building, 75 years.

1.14. Reuse, Recycling, and Energy Recovery

At end-of-life, the products may be disposed of in a landfill.

1.15. Disposal

Until a formal recycling program is established, it is assumed that all materials removed from the decommissioning of a building were taken to a local construction waste landfill, using 100 miles as the average distance to landfill. Disposal in municipal landfill or commercial incineration facilities is permissible and should be done in accordance with local, state, and federal regulations.

2. Life Cycle Assessment Background Information

2.1. Functional or Declared Unit

The declared unit for this EPD is 1 ㎡ of FeltWorks Acoustical Panels for use over 75 years.

Table 5. The declared unit of FeltWorks Acoustical Panels

NAME	VALUE	UNIT
Declared unit	1	㎡
Declared thickness	25 to 50	㎜
Weight per declared unit	3.09	kg/㎡

2.2. System Boundary

This EPD is cradle-to-installation with end-of-life. Details of the system boundaries may be found in the table below.

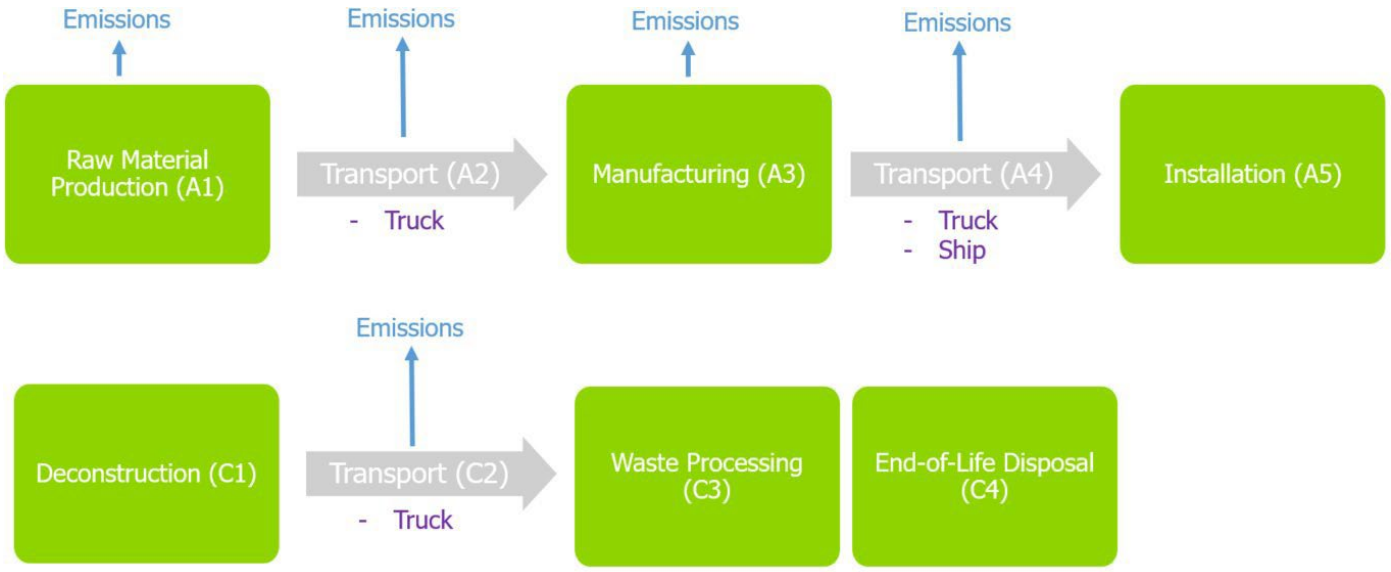


Figure3. FeltWorks System boundary

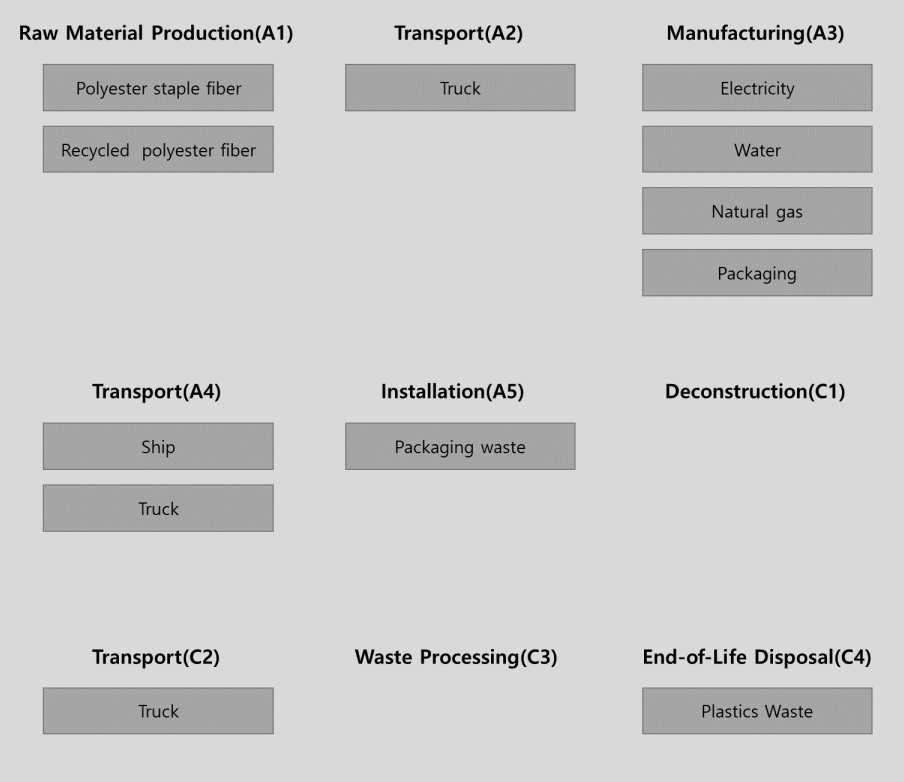


Figure4. Flow Diagram of FeltWorks Acoustical Panels

2.3. Estimates and Assumptions

FeltWorks Acoustical panels require no utilities or maintenance over its useful life; it is assumed that the product remains in service for the 75-year reference service.

2.4. Cut-off Criteria

According to the section 2.9 of PCR(UL 10010 Version 3.2), the procedure detailed in ISO 21930, section 7.1.8 was followed regarding the exclusion of inputs and outputs. For energy, mass and environmental impacts, the cut-off criteria were 1% per the standard. Per the standard "the total of neglected input flows per module shall be a maximum of 5% of energy usage, mass and environmental impacts."

Flows excluded for this study include infrastructure, capital goods and workforce burdens. Inputs and outputs associated with infrastructure (construction, maintenance and demolition of buildings/plants, road surfaces, transport equipment, etc.) are not included. This choice is based on experience from previous LCAs where the contribution from these items was negligible due to the long lifetime of the equipment compared to the high production volume of material during that lifetime. Although pallets are used in the transportation of packaged, finished FeltWorks Acoustical Panels, pallets have been excluded due to their high reuse rates since they would have a negligible impact if otherwise included.

2.5. Data Sources

Primary manufacturing data was collected from the included manufacturing locations listed in the Manufacturing section. Secondary data primarily references the GaBi database. LCI data was taken from the GaBi databases which are on the approved database list in the PCR.

2.6. Data Quality

Primary data was based on measured and calculated data from the plant which produced most of the product in calendar year 2019. It meets requirements for completeness along with temporal, geographical and technological representativeness.

2.7. Period under Review

The LCA data were collected for the calendar year 2019.

2.8. Allocation

Where it was not possible to avoid allocation, allocation was made based on product mass which is suggested by the PCR. The raw material, energy and waste data were collected and allocated based on the mass of the entire plant consumption because the products produced in the factory have different specifications (height, width, thickness, density), but are produced through the same process.

3. Life Cycle Assessment Scenarios

Table 6. Transport to the building site (A4)

NAME	VALUE	UNIT
Fuel type	diesel, low-sulfur	
Liters of fuel	2.95E-03 [4.00E-01]	l/100km
Vehicle type	EURO3, 26-28 metric ton lorry [Container ship, 27500dwt]	
Transport distance	4.63E+02 [1.10E+04]	km
Capacity utilization (including empty runs, mass based	85	%
Gross density of products transported	1.09E+02	kg/m^3
Weight of products transported (if gross density not reported)	3.09E+00	kg
Volume of products transported (if gross density not reported)	2.83E-02	m^3
Capacity utilization volume factor (factor: =1 or <1 or ≥ 1 for compressed or nested packaging products)	1	-

Table 7. Installation into the building (A5)

NAME	VALUE	UNIT
Ancillary materials	0.00E+00	kg
Net freshwater consumption specified by water source and fate (amount evaporated, amount disposed to sewer)	0.00E+00	m^3
Other resources	0.00E+00	kg
Electricity consumption	0.00E+00	kWh
Other energy carriers	0.00E+00	MJ
Product loss per functional unit	0.00E+00	kg
Waste materials at the construction site before waste processing, generated by product installation	0.00E+00	kg
Output materials resulting from on-site waste processing (specified by route; e.g. for recycling, energy recovery and/or disposal)	0.00E+00	kg
Biogenic carbon contained in packaging	1.73E-01	kg CO_2
Direct emissions to ambient air, soil and water	0.00E+00	kg
VOC content	0.00E+00	µg/m^3
	0.00E+00	

Table 8. 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	0.00E+00	kg
	Collected with mixed construction waste	3.09E+00	kg
Recovery (specified by type)	Reuse	0.00E+00	kg
	Recycling	0.00E+00	kg
	Landfill	0.00E+00	kg
	Incineration	0.00E+00	kg
	Incineration with energy recovery	0.00E+00	kg
	Energy conversion efficiency rate	0.00E+00	
Disposal (specified by type)	Product or material for final deposition	3.09E+00	kg
Removals of biogenic carbon (excluding packaging)		0.00E+00	kg CO_2

4. Life Cycle Assessment Results

Table 9. Description of the system boundary modules

	PRODUCT STAGE			CONSTRUCT-ION PROCESS STAGE		USE STAGE							END OF LIFE STAGE				BENEFITS AND LOADS BEYOND THE 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 from gate to site	Assembly/Install	Use	Maintenance	Repair	Replacement	Refurbishment	Building Operational Energy Use During Product Use	Building Operational Water Use During Product Use	Deconstruction	Transport	Waste processing	Disposal	Reuse, Recovery, Recycling Potential
EPD Type	X	X	X	X	X	MND	MND	MND	MND	MND	MND	MND	X	X	X	X	MND

MND: module not declared X: declared

4.1. Life Cycle Impact Assessment Results

The following results were obtained as a result of the life cycle impact assessment(LCIA) for FeltWorks Acoustical Panels. The LCIA results are shown through the TRACI 2.1 and CML guideline 2001 (2016).

The LCIA results are relative expressions and do not predict impacts on category endpoints, the exceedance of thresholds, safety margins or risks.

Table 10. North American Impact Assessment Results for 1m² FeltWorks Acoustical Panels

TRACI v2.1	A1-A3	A4	A5	C1	C2	C3	C4
GWP 100 [kg CO_2 eq]	9.16.E+00	6.04.E-01	9.20.E-02	0.00.E+00	6.00.E-02	0.00.E+00	1.58.E-02
ODP [kg CFC-11 eq]	4.72.E-12	1.49.E-14	1.39.E-14	0.00.E+00	2.50.E-15	0.00.E+00	3.61.E-15
AP [kg SO_2 eq]	1.63.E-02	1.67.E-02	1.40.E-04	0.00.E+00	3.39.E-04	0.00.E+00	1.03.E-04
EP [kg N eq]	1.42.E-03	5.79.E-04	3.70.E-05	0.00.E+00	2.77.E-05	0.00.E+00	8.70.E-06
POCP [kg O_3 eq]	2.44.E-01	3.11.E-01	1.24.E-03	0.00.E+00	7.54.E-03	0.00.E+00	2.03.E-03
ADP_{fossil} [MJ, LHV]	2.35.E+01	1.07.E+00	2.99.E-02	0.00.E+00	1.17.E-01	0.00.E+00	2.57.E-02

[GWP – Global Warming Potential, ODP – Ozone Depletion Potential, AP – Acifdification Potential, EP – Eutrophication Potential, POCP – Smog Formation Potential, ADP_{fossil} – Abiotic Depletion Potential of Non-renewable (fossil) energy resources]

Table 11. EU Impact Assessment Results for 1 m² FeltWorks Acoustical Panels

CML v4.2	A1-A3	A4	A5	C1	C2	C3	C4
GWP 100 [kg CO_2 eq]	9.18.E+00	6.05.E-01	9.22.E-02	0.00.E+00	5.98E-02	0.00.E+00	1.60.E+02
ODP [kg CFC-11 eq]	4.72.E-12	1.49.E-14	1.39.E-14	0.00.E+00	2.50.E-15	0.00.E+00	3.61.E-15
AP [kg SO_2 eq]	1.54.E-02	1.58.E-02	1.25.E-04	0.00.E+00	2.51.E-04	0.00.E+00	9.42.E-05
EP [kg PO_4^{-3} eq]	2.48.E-03	1.67.E-03	3.91.E-05	0.00.E+00	6.37.E-05	0.00.E+00	1.30.E-05
POCP [kg ethene eq]	1.89.E-03	6.90.E-04	3.65.E-05	0.00.E+00	9.32.E-05	0.00.E+00	7.32.E-06
$ADP_{element}$ [kg Sb-eq]	1.83.E-06	2.15.E-08	8.03.E-09	0.00.E+00	5.38.E-09	0.00.E+00	6.00.E-09
ADP_{fossil} [MJ, LHV]	1.77.E+02	7.48.E+00	2.81.E-01	0.00.E+00	8.19.E-01	0.00.E+00	2.06.E-01

[GWP – Global Warming Potential, ODP – Depletion potential of the stratospheric ozone layer, AP – Acifdification Potential of soil and water, EP – Eutrophication Potential, POCP – Photochemical Oxidant Creation Potential, ADPelement – Abiotic depletion potential (ADP-Elements) for non-fossil resources, ADPfossil – Abiotic Depletion Potential (ADP-fossil fuels) for fossil resources]

4.2. Life Cycle Inventory Results

Table 12. Resource Use for 1 m² FeltWorks Acoustical Panels

PARAMETER	A1-A3	A4	A5	C1	C2	C3	C4
RPR_E [MJ, LHV]	0.00E+00	0.00E+00	0.00E+00	0.00.E+00	0.00E+00	0.00.E+00	0.00E+00
RPR_M [MJ, LHV]	0.00E+00	0.00E+00	0.00E+00	0.00.E+00	0.00E+00	0.00.E+00	0.00E+00
$NRPR_E$ [MJ, LHV]	7.03E-01	1.79E-01	8.37E-03	0.00.E+00	1.99E-02	0.00.E+00	5.74E-03
$NRPR_M$ [MJ, LHV]	5.40E+00	0.00E+00	0.00E+00	0.00.E+00	0.00E+00	0.00.E+00	0.00E+00
SM [kg]	0.00E+00	0.00E+00	0.00E+00	0.00.E+00	0.00E+00	0.00.E+00	0.00E+00
RSF [MJ, LHV]	0.00E+00	0.00E+00	0.00E+00	0.00.E+00	0.00E+00	0.00.E+00	0.00E+00
NRSF [MJ, LHV]	0.00E+00	0.00E+00	0.00E+00	0.00.E+00	0.00E+00	0.00.E+00	0.00E+00
RE [MJ, LHV]	0.00E+00	0.00E+00	0.00E+00	0.00.E+00	0.00E+00	0.00.E+00	0.00E+00
FW [m^3]	5.05E+00	2.41E-02	9.34E-03	0.00.E+00	4.46E-03	0.00.E+00	1.61E-02

Table 13. Output Flows and Waste Categories for 1 m² FeltWorks Acoustical Panels

PARAMETER	A1-A3	A4	A5	C1	C2	C3	C4
HWD [kg]	1.27E-07	4.34E-08	6.63E-08	0.00.E+00	4.34E-08	0.00.E+00	3.67E-09
NHWD [kg]	6.48E+00	2.04E-02	1.55E-01	0.00.E+00	4.14E-03	0.00.E+00	1.04E+00
HLRW [kg] or [m^3]	0.00E+00	0.00E+00	0.00E+00	0.00.E+00	0.00E+00	0.00.E+00	0.00E+00
ILLRW [kg] or [m^3]	0.00E+00	0.00E+00	0.00E+00	0.00.E+00	0.00E+00	0.00.E+00	0.00E+00
CRU [kg]	0.00E+00	0.00E+00	0.00E+00	0.00.E+00	0.00E+00	0.00.E+00	0.00E+00
R [kg]	0.00E+00	0.00E+00	0.00E+00	0.00.E+00	0.00E+00	0.00.E+00	0.00E+00
MER [kg]	0.00E+00	0.00E+00	0.00E+00	0.00.E+00	0.00E+00	0.00.E+00	0.00E+00
EE [MJ, LHV]	0.00E+00	0.00E+00	0.00E+00	0.00.E+00	0.00E+00	0.00.E+00	0.00E+00

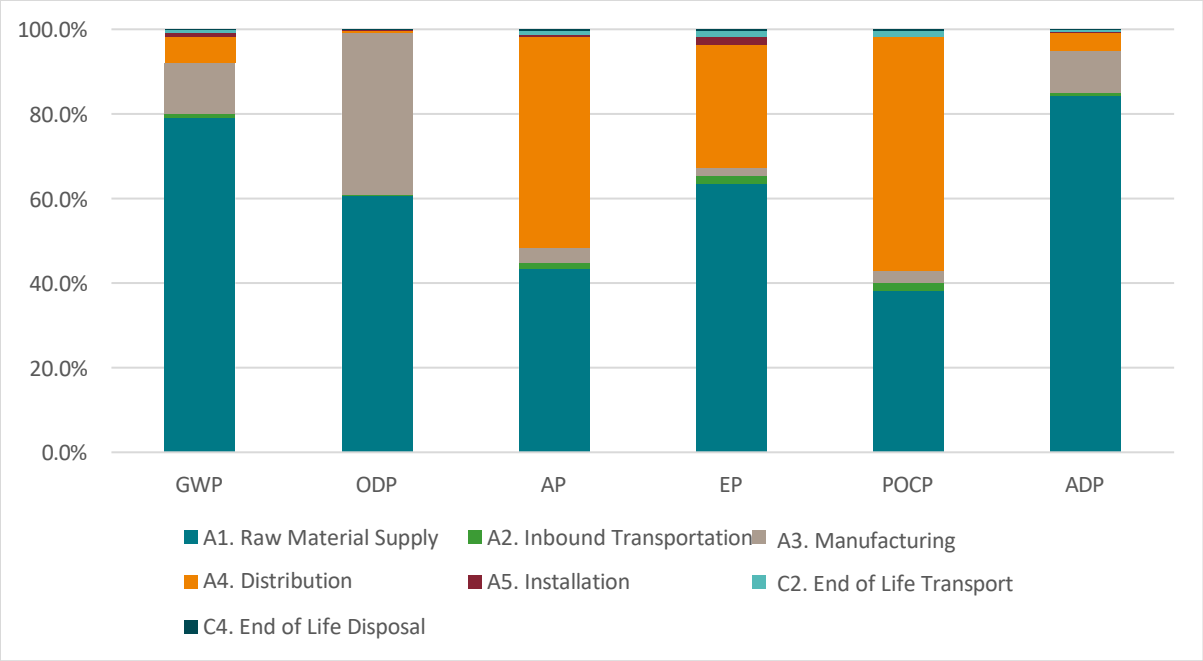
Table 14. Carbon Emissions and Removals for 1 m² FeltWorks Acoustical Panels

PARAMETER	A1-A3	A4	A5	C1	C2	C3	C4
BCRP [kg CO2]	0.00E+00	0.00E+00	0.00E+00	0.00.E+00	0.00E+00	0.00.E+00	0.00E+00
BCEP [kg CO2]	0.00E+00	0.00E+00	0.00E+00	0.00.E+00	0.00E+00	0.00.E+00	0.00E+00
BCRK [kg CO2]	0.00E+00	0.00E+00	0.00E+00	0.00.E+00	0.00E+00	0.00.E+00	0.00E+00
BCEK [kg CO2]	0.00E+00	0.00E+00	0.00E+00	0.00.E+00	0.00E+00	0.00.E+00	0.00E+00
BCEW [kg CO2]	0.00E+00	0.00E+00	0.00E+00	0.00.E+00	0.00E+00	0.00.E+00	0.00E+00
CCE [kg CO2]	0.00E+00	0.00E+00	0.00E+00	0.00.E+00	0.00E+00	0.00.E+00	0.00E+00
CCR [kg CO2]	0.00E+00	0.00E+00	0.00E+00	0.00.E+00	0.00E+00	0.00.E+00	0.00E+00
CWNR [kg CO2]	0.00E+00	0.00E+00	0.00E+00	0.00.E+00	0.00E+00	0.00.E+00	0.00E+00

5. LCA Interpretation

The underlying LCA upon which this EPD is based considered the following six environmental impact categories: Global Warming Potential (GWP 100); Ozone Depletion Potential (ODP); Acidification Potential (AP); Eutrophication Potential (EP); Smog Formation Potential (POCP); and Abiotic Resource Depletion Potential of Non-renewable (fossil) energy resources (ADP fossil).

The impact assessment results indicate that among the life cycle modules declared for FeltWorks Acoustical Panels, the Raw material supply (A1) life cycle module accounted for the majority of the potential environmental impact of each of these six impact categories.



6. Additional Environmental Information

6.1. Environment and Health During Installation

Classified as Non-Hazardous according to OHSA29CFR1910.1200.

6.2. Extraordinary Effects

No extraordinary effects or environmental impacts are expected due to destruction of the product by fire, water or mechanical means

6.3. Delayed Emissions

No delayed emissions are expected from this product.

6.4. Environmental Activities and Certifications

- SCS Indoor Advantage Gold: Products are tested for compliance and third-party certified by SCS Global to meet the CDPH Emission Standard v1.

6.5. Further Information

Additional information may be found at armstrongceilings.com/transparency

7. References

PCR A: Life Cycle Assessment Calculation Rules and Report Requirements UL Environment (December 12, 2018, version 3.2)

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