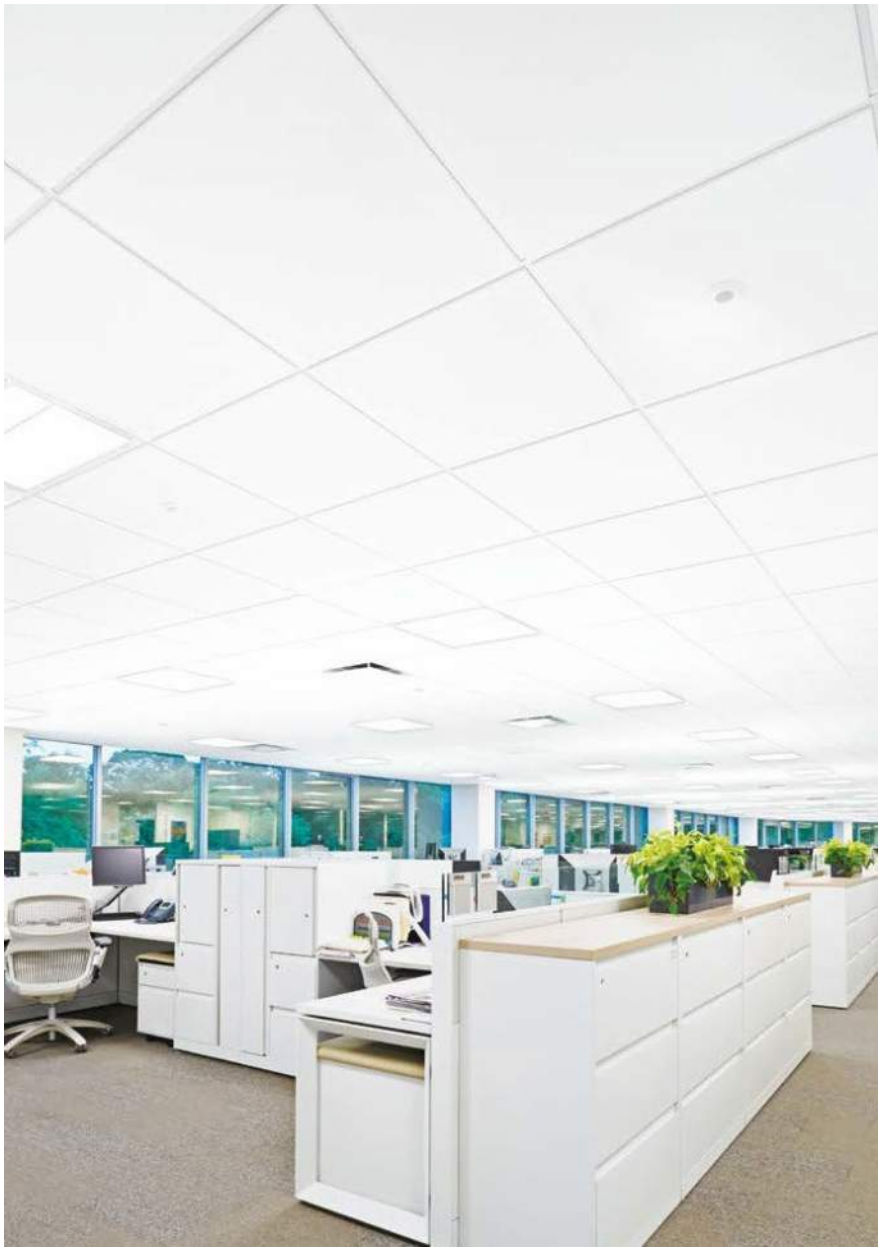
ACT-1 Tile: EPA

ENVIRONMENTAL PRODUCT DECLARATION

Calla® Ceiling Panels

HIGH PERFORMANCE MINERAL FIBER



Calla® Ceiling Panels with Suprafine® XL® Suspension System

Armstrong® 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

UL CERTIFIED ENVIRONMENTAL PRODUCT DECLARATION UL.COM/EPD

Armstrong
CEILING & WALL SOLUTIONS

CALLA® CEILING PANELS
HIGH PERFORMANCE MINERAL FIBER

1. CONTENT OF THE EPD

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 Avenue Lancaster, PA 17603
DECLARATION NUMBER (Part A and B)	4790057043.110.1
DECLARED PRODUCT & FUNCTIONAL UNIT OR DECLARED UNIT	0.093m2 (1ft2)
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)	Calla® Ceiling Panels, High Performance Mineral Fiber
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	Industry Average Only
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. ■ INTERNAL ☐ 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	

Environmental declarations from different programs (ISO 14025) may not be comparable.

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.

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.

Armstrong CEILING & WALL SOLUTIONS

CALLA® CEILING PANELS
HIGH PERFORMANCE MINERAL FIBER

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

The smoothest finish mineral fiber ceiling available with Total Acoustics® performance – excellent noise reduction and sound blocking in one product.

Features:

- DESIGNFlex® options include shapes, made-to-order sizes, and colors available to ship in 3 weeks
- Get total noise control and floor plan versatility with Total Acoustics® ceiling panels: NRC + CAC = Total Acoustics performance
- Part of the Sustain® portfolio, and meet the most stringent industry sustainability compliance standards today
- Excellent combination of acoustical performance; NRC up to 0.90, and CAC 35
- CleanAssure™ family of products – includes disinfectable panels, suspension systems, and trim
- Mold- and mildew-resistant surface
- USDA-Certified Biobased Product – 91%
- Washable, Impact-resistant, Scratch-resistant, Soil-resistant
- Product can be recycled through the Armstrong Ceilings Recycling Program
- Compatible with the TechZone® Ceiling Systems and available in any color!
- Available with factory-cut holes for USAI® trimless downlight fixture integration
- 30-Year limited system warranty against visible sag, mold, and mildew

2.2.1 Product Specific EPD

Calla® Ceiling Panels are manufactured by Armstrong World Industries in Pensacola, Florida (32505). 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).

CALLA® CEILING PANELS
HIGH PERFORMANCE MINERAL FIBER

2.2.2 Product Identification

Calla® Ceiling Panels are mineral fiber acoustical ceiling panels, featuring a fine-textured DuraBrite® surface for increased durability and superior light reflectance.

2.2.3 Product Specification

These products generally fall under ASTM E1264 Section 5.2 designation as Type III—Mineral base with painted finish.

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

This report covers the entire Calla 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.

Armstrong
CEILING & WALL SOLUTIONS

CALLA® CEILING PANELS
HIGH PERFORMANCE MINERAL FIBER

2.2.4 Flow Diagram

Calla® mineral fiber ceiling panels are manufactured using a wet-formed process. After arriving at the Armstrong manufacturing facility, the raw materials are processed and go through quality checks then mixed, water is added, and the mixture is formed into panels which are then dried. The panels are finished by application of back and prime coats, punching, lamination of scrim, final painting, cutting to size, and addition of edge detail. After packaging, the material is shipped and installed.

At the end of its useful life, the ceiling panel can then be recycled, sent to a landfill, or preferably recycled. Recycled ceilings can be returned to Armstrong World Industries as part of our closed loop recycling process as a raw material for new ceiling panels.

CALLA® CEILING PANELS
HIGH PERFORMANCE MINERAL FIBER

2.3 PRODUCT AVERAGE

2.3.2 Product Specific EPD

In this specific case of Calla mineral fiber based product EPD, data collection for energy and other raw materials input stream was specific to the manufacturing location(s) and was supported by volume-driven mathematical modeling. For all the key raw materials, primary databases were used for LCA parameters. Other primary data were collected at the facility.

2.4 APPLICATION

The products covered by this EPD are designed to be installed in a suitable metal grid system typically designed to accommodate a nominal 24" x 24", 24" x 48", 24" x 60", 24" x 72", 24" x 96", 30" x 30" panels.

2.5 MATERIAL COMPOSITION

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

Material	Calla®
Perlite	15%
Mineral Wool	73%
Fiberglass	–
Paper	4%
Starch	8%

2.6 TECHNICAL REQUIREMENTS

TABLE 1. TECHNICAL DATA

Name & Test Method	Value	Unit
Sound absorption coefficient (NRC) (ASTM C423)	0.85	NRC
Light reflectance (ASTM E1477)	0.85	n/a
Interzone attenuation of open office components (AC) (ASTM E1111 and ASTM E1110)	–	n/a
Sound Transmission Class (STC) (ASTM E413 and ASTM E90)	–	dB
Sound attenuation between rooms sharing a common ceiling plenum (CAC) (ASTM E1414 and Classification E413)	35	dB
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).

Armstrong CEILING & WALL SOLUTIONS

CALLA® CEILING PANELS
HIGH PERFORMANCE MINERAL FIBER

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 m^2 (1 ft^2) of installed ceiling panel, as defined by the PCR.

3.2 DECLARED UNIT

The declaration refers to the declared unit of 0.093 m^2 (1 ft^2) 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	0.093 m^2 (1ft^2)
Declared unit (wall, ceiling, and column panels, covers, and assemblies)	1	0.093 m^2 (1ft^2)
Declared thickness	2.54	cm
Surface weight per declared unit	4.88	kg/m^2
Density per declared unit	192.1	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)

Armstrong CEILING & WALL SOLUTIONS

CALLA® CEILING PANELS
HIGH PERFORMANCE MINERAL FIBER

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.

CALLA® CEILING PANELS
HIGH PERFORMANCE MINERAL FIBER

3.10 DATA SOURCES

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.

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

Calla® ceiling panels offer a 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.

CALLA® CEILING PANELS
HIGH PERFORMANCE MINERAL FIBER

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

Armstrong® ceiling panels are well packaged in a variety of wooden panels, rigid corrugate, and stretch wrap. Stacks of material are banded to wooden pallets for shipping.

Armstrong CEILING & WALL SOLUTIONS

CALLA® CEILING PANELS
HIGH PERFORMANCE MINERAL FIBER

4.3 TRANSPORTATION

The following information specifies any transport after the manufacturing gate. Details of type of transport, type of vehicle, distance, type, and amount of energy carrier are listed. These values are consistent with industry standard assumptions.

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	192.12	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/installationinstructions.

TABLE 5. INSTALLATION INTO THE BUILDING (A5)

Name	Value	Unit %
Ancillary materials	0	kg
Net freshwater consumption specified by water source and fate (X m^3 river water evaporated, X m^3 city water disposed to sewer)	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	3.17E-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

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.

Armstrong CEILING & WALL SOLUTIONS

CALLA® CEILING PANELS
HIGH PERFORMANCE MINERAL FIBER

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, scrap, 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	4.53E-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

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	–	

Armstrong CEILING & WALL SOLUTIONS

CALLA® CEILING PANELS
HIGH PERFORMANCE MINERAL FIBER

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

	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	
EPD Type	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

Armstrong CEILING & WALL SOLUTIONS

CALLA® CEILING PANELS
HIGH PERFORMANCE MINERAL FIBER

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 0.093m2 (1ft2)
GWP, total	Global warming potential	kg CO_2 - Eq.	3.05E-01	9.23E-02	0.00E+00	4.10E-02	4.09E-03	4.76E+00 (4.42E-01)
GWP fossil	Global warming potential	kg CO_2 - Eq.	3.89E-01	9.63E-02	0.00E+00	3.49E-02	-1.19E-03	5.59E+00 (5.19E-01)
ODP	Stratospheric ozone layer depletion	kf CFC - 11 Eq.	2.78E-09	1.94E-10	0.00E+00	-1.04E-15	1.95E-14	3.20E-08 (2.97E-09)
AP	Acidification potential	kg SO_2 - Eq.	1.50E-03	4.33E-04	0.00E+00	1.58E-04	-9.66E-06	2.24E-02 (2.08E-03)
EP	Eutrophication potential	kg N - Eq.	2.19E-04	4.33E-05	0.00E+00	1.66E-05	-1.88E-06	2.98E-03 (2.77E-04)
POCP	Photochemical ozone creation potential	kg O_3 - Eq.	4.22E-05	-7.41E-05	0.00E+00	1.93E-05	-1.32E-06	-1.49E-04 (-1.39E-05)
ADP	Abiotic resource depletion potential – fossil fuels	MJ	4.91E+00	1.29E+00	0.00E+00	3.28E-01	-2.48E-02	7.00E+01 (6.50E+00)

5.3 LCA RESULTS FROM LCI

TABLE 10. LCA RESULTS - RESOURCE USE

Parameter	Description	Unit	Total 0.093m2 (1ft2)
PERE	Renewable primary energy as energy carrier	MJ, LHV	7.79E+00 (7.24E-01)
PERM	Renewable primary energy resources as material utilization	MJ, LHV	1.30E+00 (1.21E-01)
PERT	Total use of renewable primary energy resources	MJ, LHV	9.10E+00 (8.45E-01)
PENRE	Non-renewable primary energy as energy carrier	MJ, LHV	8.58E+01 (7.97E+00)
PENRM	Non-renewable primary energy as material utilization	MJ, LHV	4.36E-01 (4.05E-02)
PENRT	Total use of non-renewable primary energy resources	MJ, LHV	8.63E+01 (8.01E+00)
SM	Use of secondary material	kg	2.92E+00 (2.71E-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	4.86E-01 (4.51E-02)

Armstrong CEILING & WALL SOLUTIONS

CALLA® CEILING PANELS
HIGH PERFORMANCE MINERAL FIBER

TABLE 11. LCA RESULTS: OUTPUT FLOWS AND WASTE CATEGORIES

Parameter	Description	Unit	Total 0.093m2 (1ft2)
HWD	Hazardous waste disposed	kg	5.23E-05 (4.86E-06)
NHWD	Non-hazardous waste disposed	kg	5.52E+00 (5.13E-01)
HLRW	Radioactive waste disposed	kg	-7.63E-06 (-7.09E-07)
ILLRW	Intermediate & Low Level Radioactive Waste	kg	-6.37E-03 (-5.92E-04)
CRU	Components for reuse	kg	0.00E+00 (0.00E+00)
MFR	Materials for recycling	kg	1.15E-01 (1.07E-02)
MER	Materials for energy recovery	kg	0.00E+00 (0.00E+00)
EEE	Exported energy	MJ, LHV	9.30E-02 (8.64E-03)

TABLE 12. CARBON EMISSIONS AND REMOVALS DESCRIPTION

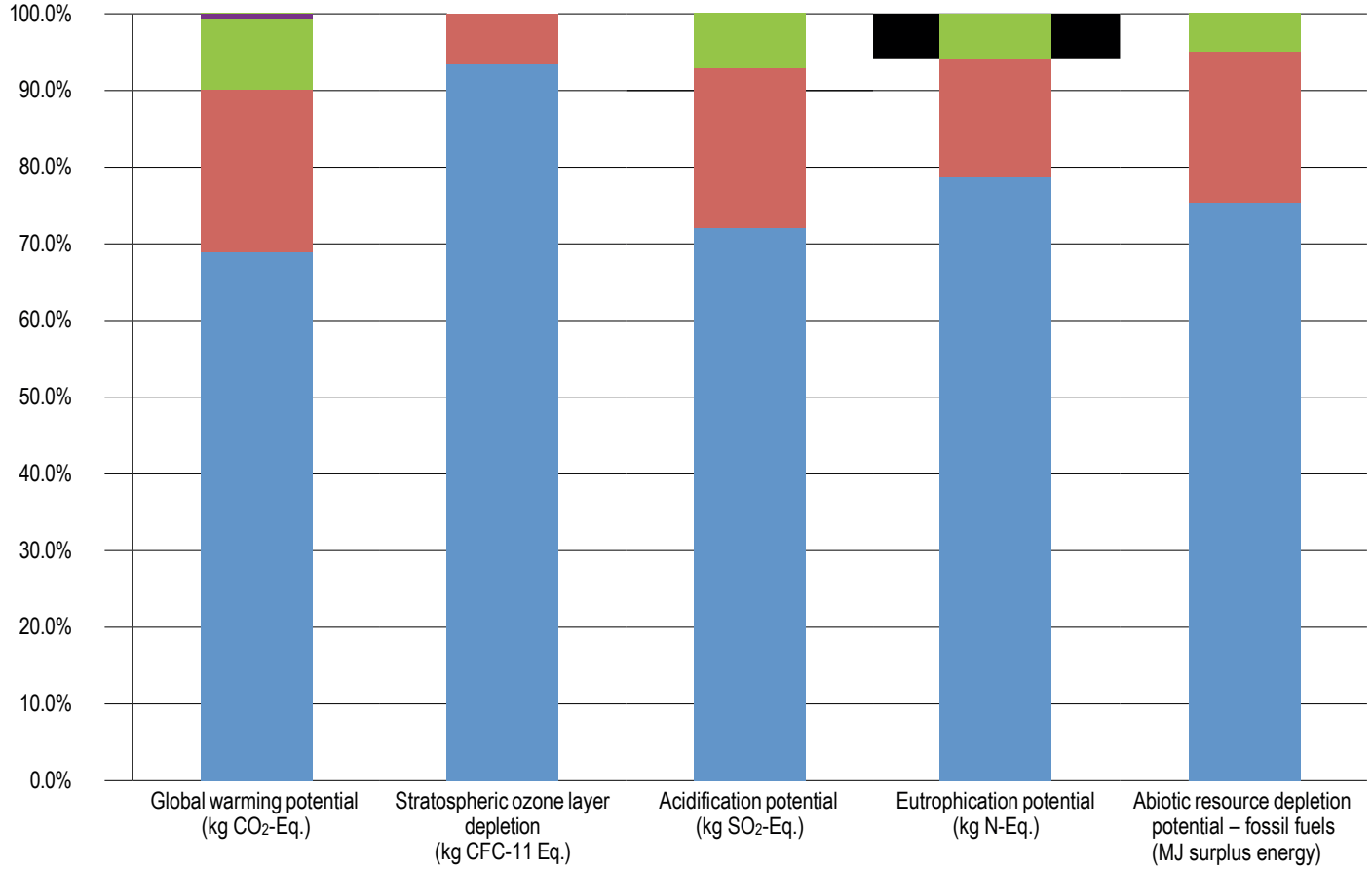
Parameter	Description	Unit	Total 0.093m2 (1ft2)
BCRP	Biogenic Carbon Removal from Product	kg CO_2	3.68E-01 (3.42E-02)
BCEP	Biogenic Carbon Emission from Product	kg CO_2	5.00E-01 (4.65E-02)
BCRK	Biogenic Carbon Removal from Packaging	kg CO_2	3.51E-01 (3.26E-02)
BCEK	Biogenic Carbon Emission from Packaging	kg CO_2	2.23E-01 (2.08E-02)

Armstrong
CEILING & WALL SOLUTIONS

CALLA® CEILING PANELS
HIGH PERFORMANCE MINERAL FIBER

6. LCA: INTERPRETATION

From the 2020 LCA 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 Calla® Ceiling 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 Calla 1" Tegular items.

Armstrong
CEILING & WALL SOLUTIONS

CALLA® CEILING PANELS
HIGH PERFORMANCE MINERAL FIBER

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

Class A: ASTM E84 and CAN/ULC S102 surface burning characteristics. Flame Spread Index of 25 or less. Smoke Developed Index 50 or less. (UL® labeled)

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 carry a 30-year limited system warranty.

Insulation Value

ASTM C518 Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus

All Calla® Items – 1" Tegular

R Factor – 2.9 (BTU units)

R Factor – 0.445 (Watts units)

Seismic Performance

Seismic Categories C, D, E, and F

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

Acoustical Panel Classification

ASTM E1264 - Standard Classification for Acoustical Ceiling Products

Type VI, Form 2, Pattern E, Fire Class A

Mechanical Destruction – Not applicable to ceiling products

7.4 DELAYED EMISSIONS

Our products contain a number of biobased ingredients such as starch, cellulose, or recycled newspaper, etc. The carbon stored in these products is effectively treated as equal, to avoiding fossil fuel emissions while calculating the carbon footprint. There is certainly a benefit to such carbon storage, potential delayed emissions in future extending to several decades are possible. Therefore, we included both total and fossil-fuel-based global warming potential in our results tables.

7.5 ENVIRONMENTAL ACTIVITIES AND CERTIFICATIONS

All environmental certifications can be found at: Armstrongceilings.com

Calla: armstrongceilings.com/commercial/en-us/commercial-ceilings-walls/ceilings/Calla-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

Armstrong CEILING & WALL SOLUTIONS

CALLA® CEILING PANELS
HIGH PERFORMANCE MINERAL FIBER

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)

CALLA® CEILING PANELS
HIGH PERFORMANCE MINERAL FIBER

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/owadisp.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)

UL® and the UL® logo are trademarks of UL LLC
All other trademarks used herein are the property of AWI Licensing LLC and/or its affiliates.
© 2021 AWI Licensing LLC

BPCS-5307-921