

ENVIRONMENTAL PRODUCT DECLARATION

PRELUDE® SUSPENSION SYSTEMS

STEEL



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.

For more information visit
armstrongceilings.com/transparency



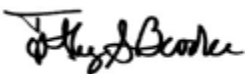
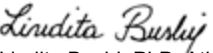
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According to ISO 14025 AND ISO 21930

1. CONTENT OF THE EPD

EPD PROGRAM AND PROGRAM OPERATOR NAME, ADDRESS, LOGO, AND WEBSITE	ASTM International – 100 Barr Harbor Drive, West Conshohocken, PA, 19428, USA www.astm.org
GENERAL PROGRAM INSTRUCTIONS AND VERSION NUMBER	ASTM Program Operator for Product Category Rules (PCR) and Environmental Product Declarations (EPDs), General Program Instructions, Version: 8.0, Revised 04/29/20.
MANUFACTURER NAME AND ADDRESS	Armstrong World Industries 2500 Columbia Avenue Lancaster, PA 17603
DECLARATION NUMBER	364
DECLARED PRODUCT & FUNCTIONAL UNIT OR DECLARED UNIT	1 linear meter
REFERENCE PCR AND VERSION NUMBER	PCR for Building-Related Products and Services – Part A: LCA Calculation Rules and Report Requirements, UL 10010 v.3.2, December 2018. PCR Guidance for Building-Related Products and Services – Part B: Metal Ceiling and Interior Wall Panel System EPD Requirements, UL Environment, UL 10010–12, v1, 01/2020.
DESCRIPTION OF PRODUCT'S INTENDED APPLICATION AND USE (AS IDENTIFIED WHEN DETERMINING PRODUCT RSL)	Prelude® Suspension Systems including 360° Painted Grid
PRODUCT RSL DESCRIPTION (IF APPL.)	75 Years
MARKETS OF APPLICABILITY	North America
DATE OF ISSUE	December 17, 2022
PERIOD OF VALIDITY	5 years
EPD TYPE	Product-Specific
EPD SCOPE	Cradle to Gate
YEAR(S) OF REPORTED MANUFACTURER PRIMARY DATA	2021
LCA SOFTWARE & VERSION NUMBER	GaBi 10.6.1.35
LCI DATABASE(S) & VERSION NUMBER	GaBi 2022.1
LCIA METHODOLOGY & VERSION NUMBER	TRACI 2.1
The sub-category PCR review was conducted by:	
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," v3.2 (September 2018), in conformance with ISO 21930:2017, serves as the core PCR.	
☐ INTERNAL ☒ EXTERNAL	Tim Brooke, ASTM International
This life cycle assessment was conducted in accordance with ISO 14044 and the reference PCR by:	Armstrong World Industries
This life cycle assessment was independently verified in accordance with ISO 14044 and the reference PCR by:	 Lindita Bushi, PhD, Athena Sustainable Materials Institute lindita.bushi@athenaasmi.org
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 in results for upstream or downstream of the life cycle stages declared. ASTM certification of this EPD is not to be construed as representing aesthetics or any other attributes not specifically addressed, nor should it be construed as an ASTM endorsement of the subject of the EPD or a recommendation for its use. There is no warranty by ASTM, express or implied, as to any finding or other matter in the EPD, or as to any product covered by the EPD. The EPD holder is liable for the information and evidence on which the EPD is based.	



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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

Prelude® Suspension Systems are hot-dipped galvanized steel without hanger wires, molding, or attachment/hold down clips (UNSPSC Code 25172000 and CSI 09-53-00). Prelude is manufactured in Aberdeen, MD (21001), Benton Harbor, MI (49022) and Las Vegas, NV (89031).



Figure 1. Prelude Suspended Ceiling System

Features:

- Hot-dipped galvanized coating inhibits red rusting better than electrogalvanized or painted systems
- XL® staked-on end detail provides secure locked connection: easy to remove, reuse, and relocate
- PeakForm® profile increases strength and stability for improved performance during installation
- SuperLock™ main beam clip is engineered for a strong, secure connection and fast, accurate alignment confirmed with an audible click; easy to remove/relocate
- Fire Guard™ options offer UL® design fire-rated performance
- 10-Year Limited System Warranty; 30-Year Limited Ceiling Systems Warranty when used with HumiGuard® Plus products
- 10-Year replacement items available
- Seismic Rx® Suspension System saves time and money; Armstrong Ceilings offers an ICC-ES approach to installations (ESR-1308)
- Part of the Sustain™ portfolio and meets the most stringent industry sustainability compliance standards today
- CleanAssure™ family of products – includes disinfectable panels, suspension systems, and trim

2.2.1 Product Identification

Prelude® hot-dipped galvanized steel 15/16" suspension system offers up to 25% recycled content for improved LEED® credits.



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2.2.2 Product Specification

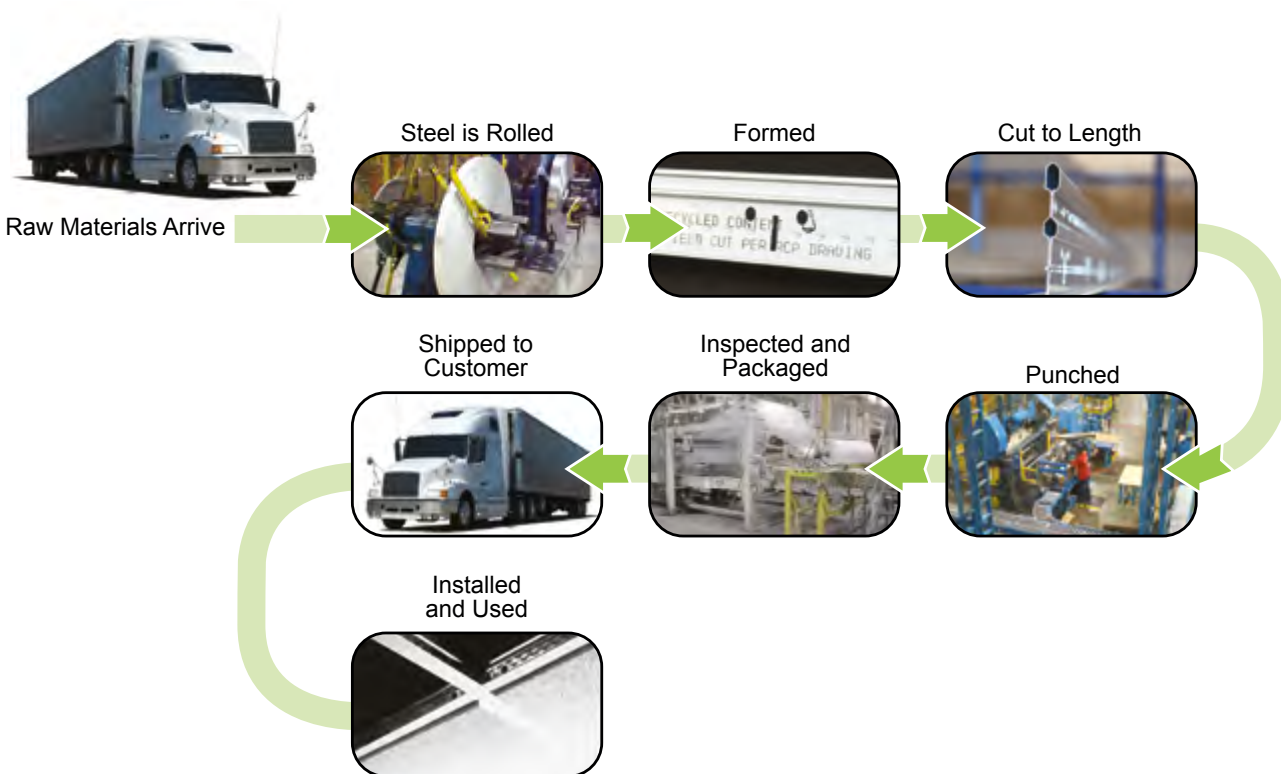
15/16" Exposed Tee G30 system; hot-dipped galvanized steel with baked polyester paint or powder coated finish manufactured and tested in accordance with ASTM C635, Standard Specification for Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings, Seismic Performance: C, D, E and F; ICC-ES ESR 1308.

This report covers Prelude products and was developed using a weighted average approach.

2.2.3 Flow Diagram

Armstrong® suspension systems use hot dipped galvanized steel which is formed into coils. The coils are split and painted, and then sent to Armstrong World Industries. At the Armstrong Ceilings plant, the steel is pressed, roll formed, punched, and packaged. The material is then shipped and installed. When the system is disassembled, the majority of the steel is recycled.

PROCESS FOR MANUFACTURING STEEL SUSPENSION SYSTEMS



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2.3 PRODUCT AVERAGE

2.3.2 Product-Specific EPD

In this specific case of Prelude® Suspension System 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 direct-attach method to support the installation of ceiling tiles.

2.5 MATERIAL COMPOSITION

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

Material	Prelude®
Hot-dipped Galvanized Steel	>98%
Paint	<2%

2.6 TECHNICAL REQUIREMENTS

Prelude Suspension ceiling systems are manufactured and tested in accordance with ASTM C635 and should be installed in accordance with C635 Standard Specification for Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings.

3. METHODOLOGICAL FRAMEWORK

This study provides a life cycle inventory and environmental impacts relevant to Armstrong Suspension Systems. The LCA follows an attributional approach as outlined in ISO 21930 Section 7.1.1- see also PCR Part A-6. 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 for Building-Related Products and Services Part A: Life Cycle Assessment Calculation Rules and Report Requirements, UL 10010 v3.2, December 2018 and Product Category Rules for Building-Related Products and Services Part B: Metal Ceiling and Interior Wall Panel System EPD Requirements, UL 10010. 2020.

3.1 DECLARED UNIT PROPERTIES

TABLE 2. FUNCTIONAL OR DECLARED UNIT PROPERTIES

Name	Value	Unit
Declared Unit	1 (3.28)	m (ft2)
Thickness 2.38 (15/16)	2.38 (15/16)	inches
Weight	0.022 (0.16)	kg/m (lbs/ft)
Density	231.5 (14.6)	kg/m3 (lb/ft3)

3.2 SYSTEM BOUNDARY

The LCA is “cradle-to-gate” for 1 linear meter of ceiling tile. Details of inclusions and exclusions from the system boundary are listed below.



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THE CRADLE-TO-GATE ASSESSMENT:

Includes	Excludes
– 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) – Treatment of waste and waste water (A3)	– Construction of capital equipment – Maintenance and operation of support equipment – Human labor and employee commute – Low-volume product coatings – Transportation to job site (A4) – Construction and installation (A5) – Use stage (B1-B7) – Disposal stage (C1-C4) – Benefits and loads beyond the system boundary (D)

3.3 REFERENCE SERVICE LIFE AND ESTIMATED BUILDING SERVICE LIFE

In accordance with the PCR, the Reference Service Life (RSL) for this study was assumed to be 30 years and the Estimated Service Life was assumed to be 75 years.

3.4 ALLOCATION

Allocation based on linear feet of the product output was used to allocate manufacturing inputs including energy, water, waste and emissions. This allocation method was selected, because product is manufactured, sold and installed based on linear feet.

3.5 CUT-OFF RULES

No known flows are deliberately excluded from this EPD. 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. No known flows are deliberately excluded from this EPD.

3.6 DATA SOURCES

Primary data for this study was collected from the manufacturing facility for 2021 and datasets for materials upstream from manufacturing were obtained from the GaBi database version 10.6.1.35.

3.7 DATA QUALITY

The data quality ranges from good to very good. The temporal quality of the data is very good with both manufacturing specific data and GaBi background data from 2021. Because primary and secondary data were collected specific to the location of manufacture when possible, the geographical representativeness is considered to be good.

3.8 PERIOD UNDER REVIEW

All the primary data in the scope of this analysis was collected from Armstrong manufacturing facilities during 2021.

3.9 COMPARABILITY AND BENCHMARKING

We do not have any data on comparable non-competitive products to report.



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3.10 ESTIMATES AND ASSUMPTIONS

The datasets for materials upstream from manufacturing are from the GaBi database. When inventories were not available for materials, conservative proxy datasets were chosen based on similarity of material.

3.11 UNITS

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

4. TECHNICAL INFORMATION AND SCENARIOS

Data is reported as a weighted average for Prelude Suspension System production.

4.1 MANUFACTURING

The manufacturing process has been described in a simple flow chart in Section 2.2.4.

Based on 2021 data, ~6.82E-03 kg of non-hazardous waste is generated per 1 linear meter of production.

4.2 PACKAGING

Armstrong® suspension systems are packaged in a variety of recyclable corrugated sleeves and box styles. Wooden pallets are used to protect unit loads during shipping.

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



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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 Gate 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 (X = INCLUDED IN LCA; MND - MODULE NOT DECLARED)

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	Deconstruction	Deconstruction	Transport	Waste processing	Disposal	Reuse, Recovery, Recycling Potential
						B6 Operational Energy Use of Building Integrated System During Product Use											
						B7 Operational Water Use of Building Integrated System During Product Use											
Cradle to Gate	X	X	X	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND	MND



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5.2 LCA RESULTS FROM LCI

Life cycle impacts reported below are based on TRACI 2.1 methodology. Results are provided in reference to the declared unit, and for convenience of the reader we have included additional grouping across the system boundaries. For the other impact categories, results are presented in the tables below. The global warming potential (GWP 100) provided in Table 9 excludes biogenic carbon. These six impact categories are globally deemed mature enough to be included in Type III environmental declarations. Other categories are being developed and defined and LCA should continue making advances in their development. However, the EPD users shall not use additional measures for comparative purposes.

TABLE 9. LIFE CYCLE ASSESSMENT RESULTS FOR 1 LINEAR METER

Parameter	Unit	Source	A1	A2	A3
Global Warming Potential (GWP 100)	kg CO2 eq.	TRACI 2.1	6.52E-02	1.79E-03	7.45E-04
Ozone Depletion Potential (ODP)	kg CFC 11 eq.	TRACI 2.1	8.42E-16	3.21E-18	1.87E-14
Acidification Potential (AP)	kg SO2 eq.	TRACI 2.1	1.57E-04	2.48E-05	3.47E-06
Eutrophication Potential (EP)	kg N eq.	TRACI 2.1	7.82E-06	1.18E-06	7.20E-07
Smog Formation Potential (SFP)	kg O3 eq.	TRACI 2.1	2.33E-03	5.18E-04	9.14E-05
Abiotic Resource Depletion (ADP (fossil))	MJ, LHV	CML 2016	7.68E-01	2.43E-02	9.81E-03
Resources, Fossil fuels (ADP(fossil))	MJ surplus	TRACI 2.1	3.88E-02	3.24E-03	1.25E-03

5.3 LCA RESULTS FROM LCI

When transforming the inputs and outputs of combustible materials into energy, the lower caloric value of fuels (LHV) was applied according to scientifically based and accepted values specific to the combustible material as shown in Table 10.

TABLE 10. LCA RESULTS FOR 1 LINEAR METER

Parameter	Description	Unit	A1	A2	A3
RPre	Renewable primary resources used as energy carrier (fuel)	MJ, LHV	2.67E-02	7.09E-04	2.45E-02
RPRm	Renewable primary resources with energy content used as material	MJ, LHV	0.00E+00	0.00E+00	6.94E-04
NRPRE	Non-renewable primary resources used as an energy carrier (fuel)	MJ, LHV	7.91E-01	2.45E-02	1.06E-02
NRPRM	Non-renewable primary resources with energy content used as material	MJ, LHV	0.00E+00	0.00E+00	0.00E+00
SM	Secondary materials	kg	2.32E-03	1.78E-06	1.01E-04
RSF	Renewable secondary fuels	kg	0.00E+00	0.00E+00	0.00E+00
NRDF	Non-renewable secondary fuels	m3	0.00E+00	0.00E+00	0.00E+00
RE	Recovered Energy	MJ, LHV	0.00E+00	0.00E+00	0.00E+00
FW	Use of net fresh water	m ³	1.29E-02	2.48E-06	8.33E-06

TABLE 11. LCA RESULTS: OUTPUT FLOWS AND WASTE CATEGORIES FOR 1 LINEAR METER

Parameter	Description	Unit	Total
HWD	Hazardous waste disposed	kg	6.29E-10
NHWD	NHWD Non-hazardous waste disposed	kg	2.42E-03
HLRW	HLRW High-level radioactive waste, conditioned, to final repository	kg	4.09E-09
ILLRW	Intermediate- and low-level radioactive waste, conditioned, to final repository	kg	3.51E-06
CRU	Components for re-use	kg	0
MR	Materials for recycling	kg	0
MER	Materials for energy recovery	kg	0
EE	Recovered energy exported from the product system	MJ	0.00E+00



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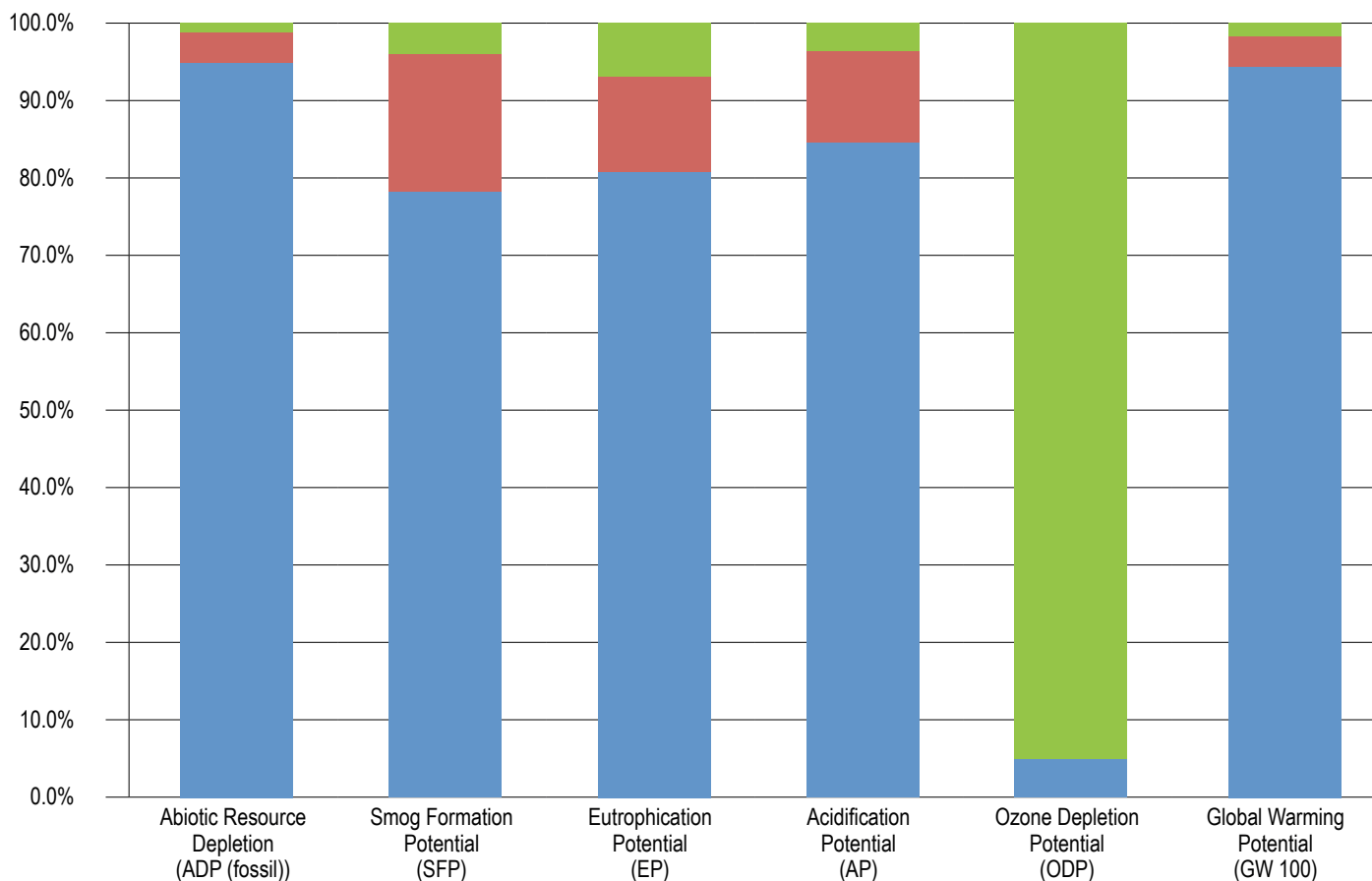


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6. LCA: INTERPRETATION

From the 2022 LCA Model of the suspension system life cycle covered in this study, it was concluded that the raw materials have the greatest impact on “carbon footprint” as represented by Global Warming Potential [GWP]. Steel is the primary raw material and may account for 80-99% of the overall impact category.



KEY

- A1. Raw materials
- A2. Transport
- A3. Production

Life Cycle Impact Assessment of Prelude Suspension System¹ relative importance in percentage terms raw materials, transport and production of the ceiling suspension system stages for the ceiling panel.

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



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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 QUALITY

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.

7.4 ENVIRONMENTAL ACTIVITIES AND CERTIFICATIONS

All environmental certifications can be found at: Armstrongceilings.com

Prelude®: armstrongceilings.com/commercial/en/suspension-systems/ceiling-grid/prelude-exposed-grid.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

7.5 FURTHER INFORMATION

Additional Information can be found at: armstrongceilings.com 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



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8. PROJECT REPORT AND SUPPORTING DOCUMENTATION

The methods for conducting the life cycle assessment upon which the results in this EPD are based 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 for Building-Related Products and Services Part A: Life Cycle Assessment Calculation Rules and Report Requirements, UL 10010 v3.2, December 2018.

Product Category Rules for Building-Related Products and Services Part B: Metal Ceiling and Interior Wall Panel System EPD Requirements, UL 10010. 2020.

9. REFERENCES

ISO 14025:2006 – Environmental labels and declarations – Type III environmental declarations – Principles and procedures

ISO 14040 -Environmental management – Life Cycle Assessment – Principles and framework, Amd 1: 2020

ISO 14044 -Environmental management – Life Cycle Assessment – Requirements and guidelines, Amd 1: 2017 / Amd 2:2020

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

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

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

Product Category Rules for Building-Related Products and Services Part A: Life Cycle Assessment Calculation Rules and Report Requirements, UL 10010 v3.2, December 2018

Product Category Rules for Building-Related Products and Services Part B: Metal Ceiling and Interior Wall Panel System EPD Requirements, UL 10010. 2020

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