Environmental Product Declaration

Prelude® XL® Suspension System

STEEL

Armstrong® CEILING SOLUTIONS

Committed to Sustainability.

Armstrong World Industries is committed to delivering solutions that reduce the environmental impact of the buildings you create; from product design and raw material selection, to how our products are produced and delivered.

Now we provide Environmental Product Declarations (EPD's) to document the sustainability of our products. Inside this UL Environment certified ISO compliant EPD you will find:

- Performance features like fire, humidity, corrosion, and seismic
- Product application and use
- Product ingredients and their sources
- Information on how suspension systems are produced
- Life Cycle Assessment (LCA) results including global warming potential and primary energy usage
- Total impacts over the life cycle of the product

UL CERTIFIED
ENVIRONMENTAL PRODUCT DECLARATION
UL.COM/EPD

Armstrong CEILING SOLUTIONS

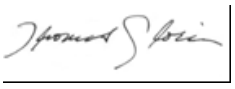
PRELUDE® XL® SUSPENSION SYSTEM
STEEL

According to ISO 14025

1. General Information

This declaration is an environmental product declaration (EPD) in accordance with ISO 14025. EPDs rely on Life Cycle Assessment (LCA) to provide information on a number of environmental impacts of products over their life cycle. 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, and the level of accuracy in estimation of effect differs for any particular product line and reported impact. Comparability: EPDs are not comparative assertions and are either not comparable or have limited comparability when they cover different life cycle stages, are based on different product category rules or are missing relevant environmental impacts. EPDs from different programs may not be comparable.

PROGRAM OPERATOR	UL Environment
DECLARATION OPERATOR	Armstrong
DECLARATION NUMBER	4787532757.101.1
DECLARED PRODUCT	**Prelude XL®** – Suspension System
REFERENCE PCR	North American Product Category Rule for Designated Steel Construction Products by SCS Global Services, May 5, 2015 V.1.O
DATE OF ISSUE	October 7, 2016
PERIOD OF VALIDITY	5 Years
CONTENTS OF THE DECLARATION	Product definition and information about building physics Information about basic material and the material's origin Description of the product's manufacture Indication of product processing Life cycle assessment results Testing results and verifications

The PCR review was conducted by:	SCS Global Services
	PCR Review Panel
	Chair: Thomas P. Gloria
This declaration was independently verified in accordance with ISO 14025 by Underwriters Laboratories ☐ INTERNAL ☒ EXTERNAL	
	Wade Stout, UL Environment
This life cycle assessment was independently verified in accordance with ISO 14044 and the reference PCR by:	
	Thomas Gloria, Industrial Ecology Consultants

2. Product Information

2.1 Product Description

Armstrong® Prelude XL® Suspension Systems are hot-dipped galvanized steel 15/16" suspension systems that offer high recycled content for improved LEED® credits. Prelude XL is manufactured by Armstrong World Industries in Aberdeen, Maryland (21001), Benton Harbor, Michigan (49022), and Las Vegas, Nevada (89031).

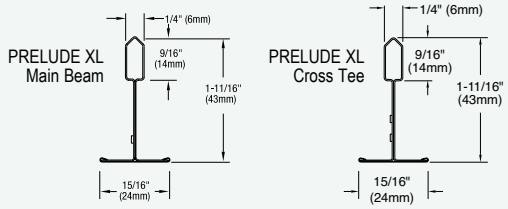
2.2 Application

Commercial Interior Finish. Acoustical, Suspended Ceiling System. The ceiling system must be installed in accordance with Armstrong 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/sustain.

2.3 Technical Data

There are different levels of performance associated with suspension systems. Performance information is included in this EPD to provide a total understanding of this product and its performance attributes.

Performance of Prelude XL Suspension Systems

Items Included in this EPD	Attributes
Prelude® XL® Prelude XL High Recycled Content Prelude Plus XL for Exterior Applications 	**Fire** **Humidity** Exterior CASTM (635) Severe weather performing **Seismic** ESR-1308

2.4 Placing On the Market/Application Rules

The respective standard is listed in the table in Section 2.3 above for each attribute of the declared product.

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

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

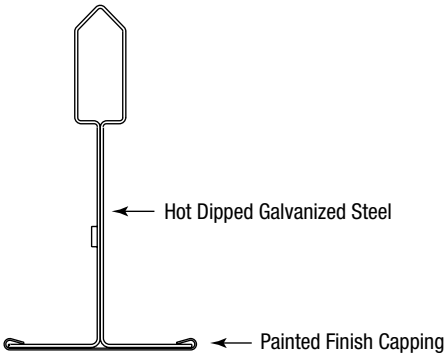
EN 14044 ISO 14044:2006, Environmental management – Life cycle assessment – Requirements and guidelines

2. Product Information (continued)

2.5 Material Content

– **Painted Finish** – Painted steel capping

Figure 1. Composition of Prelude® XL® Suspension Systems



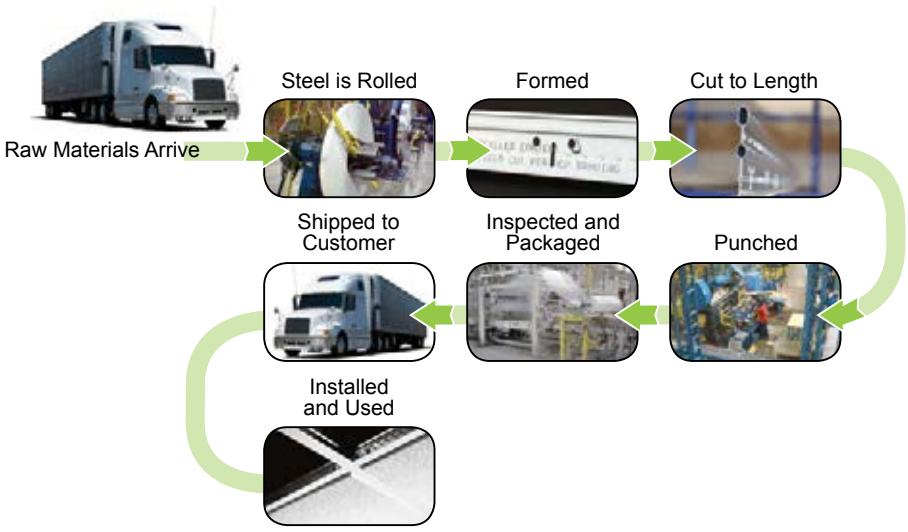
Material Content of Suspension Systems

Components	FUNCTION	QUANTITY (PERCENT BY WEIGHT)	RECYCLED MINERAL RESOURCE	MINERAL RESOURCE	NON-RENEW-ABLE	RENEW-ABLE	ABUNDANT	RECYCLED MATERIAL	ORIGIN	TRANS-PORTATION MODE	TRANS-PORTATION MILES
Hot Dipped Galvanized Steel	Suspension	>98%	■	■	■		■	■	Global	Truck	500-600
Paint	Finish	<2%		■	■				U.S.	Truck/Rail	200-500

2. Product Information (continued)

2.6 Manufacture

Process for Manufacturing Steel Suspension Systems



Armstrong® suspension systems use hot dipped galvanized steel which is formed into coils. A large component of the steel is recycled material. 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.

2.7 Health, Safety, and Environmental Aspects 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. 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. In 2010, Armstrong was named one of "America's Safest Companies" by EHS Today.

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.

2.8 Installation of Suspension Systems

The suspension 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 www.armstrongceilings.com/installationinstructions.

2.9 Packaging

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

2. Product Information (continued)

2.10 Health, Safety, and Environmental Aspects During Installation

There are no recognized systemic hazards associated with installing a suspension system. Armstrong World Industries recommends that installers handle materials in a manner to avoid injury from cut edges of metal parts. Installers should wear appropriate personal protective equipment, such as gloves and safety glasses to avoid injury when working with metal parts.

2.11 Reference Service of Life

Per the PCR the reference service life for this product is not specified.

2.12 Extraordinary Effects

– **Seismic Performance**

Seismic Categories C, D, E, and F

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

3. Life Cycle Assessment

This study provides life cycle inventory and environmental impacts relevant to Armstrong® Prelude XL Suspension Systems. This LCA was conducted to better understand the environmental impacts of the suspension systems and learn how the impacts of raw material selection, product formulation, and manufacturing processes influence the life cycle impacts.

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 the requirements outlined in the North American Product Category Rule for Designated Steel Construction Products.

3.1 Declared Unit

The declared unit for this EPD is 1 metric ton of Prelude XL. The reference service life is not specified per the PCR.

Prelude XL	
Declared Unit	1 metric ton
Declared Density (kg/m^3)	8050 kg/m^3

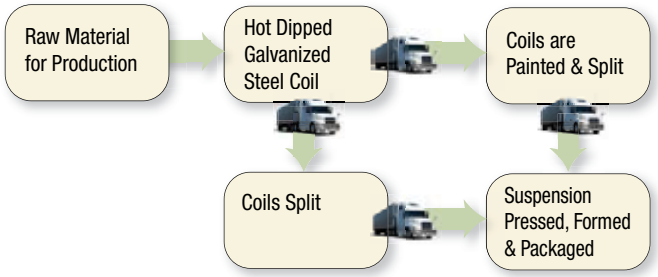
3. Life Cycle Assessment (continued)

3.2 System Boundaries:

The system boundary for this PCR is the Product Stage, which includes information modules A1 to A3.The system boundaries studied as part of this life cycle assessment include extraction of primary materials, raw materials manufacture, suspension system production, and packaging.

The phases below outline a life cycle assessment for suspension systems.

Life Cycle Phases Included for the Steel Suspension System in Study:



The Assessment Includes:

– Raw materials production including substrate, coating, and packaging materials for suspension systems

– Transportation of raw materials to Armstrong manufacturing facility

– Manufacturing of the suspension systems at an Armstrong manufacturing facility

– Packaging of finished products including energy to operate packaging equipment

The Assessment Excludes:

– Overhead energy usage (heating, lighting) of manufacturing facilities

– Maintenance and operation of support equipment

3.3 Assumptions:

No particular assumptions were taken into consideration within the model.

3.4 Cut-off Criteria:

– Mass – If a flow is less than 1% of the cumulative mass of the model, it is excluded, providing its environmental relevance is not a concern.

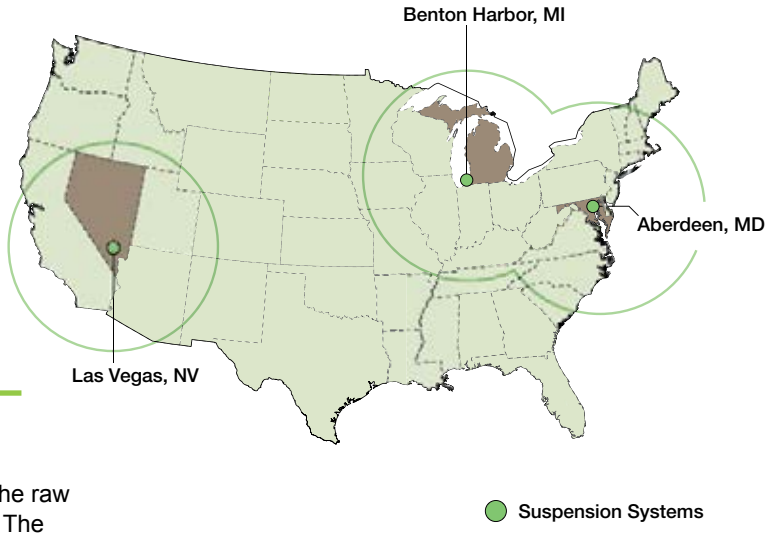
– Energy – If a flow is less than 1% of the cumulative energy of the model, it is excluded, providing its environmental relevance is not a concern.

– Environmental relevance – If a flow meets the above criteria for exclusion, yet is believed to potentially have a significant environmental impact, it is included.

3.Life Cycle Assessment (continued)

3.5 Background Data:

All data is reported as a North American weighted average across our steel suspension system manufacturing locations. The map shows the location of each of our manufacturing facilities for the steel suspension systems. We have plants located in Las Vegas, NV; Aberdeen, MD; and Benton Harbor, MI. Steel is purchased at multiple locations including Pennsylvania, Georgia, Texas, South Carolina, California, South Africa, India, Taiwan, and Japan. Secondary gaBi datasets were utilized for all raw materials. All transportation associated with raw materials reflects the actual modes of transportation and mileage.



3.6 Data Quality:

The LCA model was created using the gaBi Software system for life cycle engineering, developed by Think Step. The gaBi database provides the life cycle inventory data for several of the raw and process materials obtained from the background system. The data quality is considered to be good to high quality. With the exception of supplier specific data, all other relevant background data was taken from the gaBi database software.

All gate-to-gate, primary foreground data was collected for the suspension system manufacturing process. Background data was collected from suppliers or generic data was used. When generic data was used, it was verified and triangulated against several sources.

3.7 Period Under Review

Calendar year 2014 manufacturing data was used to create the LCA model.

3.8 Allocation:

Since this EPD does not cover the end-of-life of the products, end-of-life allocation is outside the scope of the study.

4. LCA: Results

Disclaimer: This Environmental Product Declaration (EPD) conforms to ISO 14025, ISO 14040, ISO 14044, and ISO 21930.

Scope of Results Reported: The PCR requires reporting of a limited set of LCA metrics; therefore, there may be relevant environmental impacts beyond those disclosed by this EPD. This EPD does not indicate that any environmental or social performance benchmarks are met nor thresholds exceeded.

Accuracy of Results: This EPD has been developed in accordance with the PCR applicable for the identified products following the principles, requirements and guidelines of the ISO 14040, ISO 14044, ISO 14025, and ISO 21930 standards. The results in this EPD are estimations of potential impacts. The accuracy of the results in different EPDs may vary as a result of value choices, background data assumptions and quality of data collected.

Comparability: EPDs are not comparative assertions and are either not comparable or have limited comparability when they cover different life cycle stages, are based on different product category rules or are missing relevant environmental impacts. Such comparisons can be inaccurate, and could lead to erroneous selection of materials or products which are higher-impact, at least in some impact categories. Any comparison of EPDs shall be subject to the requirements of ISO 21930. For comparison of EPDs which report different module scopes, such that one EPD includes Module D and the other does not, the comparison shall only be made on the basis of Modules A1, A2, and A3. Additionally when Module D is included in the EPDs being compared, all EPDs must use the same methodology for calculation of Module D values.

The Life Cycle Assessment (LCA) was performed according to ISO 14040 and follows the PCR instructions. The cradle-to-grave LCA encompasses raw material production; transport of raw materials to production facility; manufacturing of the suspension system and packaging.

Table 1. Description of the system boundary (X = Included in LCA; NS = Not in Scope

	PRODUCT STAGE			CONSTRUCTION PROCESS STAGE		USE STAGE							END OF LIFE STAGE				BENEFITS AND LOADS BEYOND THE SYSTEM BOUNDARIES
	Raw Material supply	Transport	Manufacturing	Transport from gate site	Assembly/Install	Use	Maintenance	Repair	Replacement	Refurbishment	Operational Energy Use	Operational Water Use	Deconstruction	Transport	Waste processing	Disposal	Reuse, Recovery, Recycling potential
EPD type	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
Gate to Gate for 1 tonne	X	X	X	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

4. LCA: Results (continued)

Life Cycle Environmental Impact Results: 1 M² – Consistent Declared Unit

Declared Unit: 1 metric ton of steel suspension system

Table 2. North American LCA Environmental Impact Results

TRACI 2.1 Impact Assessment, October 2013						
Impact Category	**Parameter**	**Unit**	**A1. Raw materials**	**A2. Transport**	**A3. Production**	**A1-A3**
Global Warming	Global warming potential (GWP)	metric ton CO2- Eq.	2.35E+00	7.87E-02	5.67E-03	2.43E+00
Ozone Depletion	Depletion potential of the stratospheric ozone layer (ODP)	metric ton CFC-11 Eq.	2.96E-08	6.32E-13	1.08E-12	2.96E-08
Acidification of Land and Water	Acidification potential of soil and water (AP)	metric ton SO2- Eq.	9.07E-03	1.07E-03	1.35E-04	1.03E-02
Eutrophication	Eutrophication potential (EP)	metric ton N- Eq.	4.43E-04	5.10E-05	3.01E-05	5.24E-04
Photochemical Ozone Creation	Formation potential of tropospheric ozone (POCP)	metric ton O3- Eq.	1.22E-01	2.34E-02	3.24E-03	1.48E-01
Depletion of Abiotic Resources (Elements)*	Abiotic depletion potential (ADP-elements) for non-fossil resources	metric ton Antimony Eq.	-1.05E-07	1.10E-08	1.30E-08	-8.09E-08
Depletion of Abiotic Resources (Fossil)	Abiotic depletion potential (ADP-fossil fuels) for fossil resources	MJ, net calorific value	2.67E+04	1.05E+03	4.21E+02	2.81E+04

* This indicator is based on assumptions regarding current reserves estimates. Users sould use caution when interpreting results because there is insufficient information on which the indicator is best for assessing the depletion of abiotic resources.

Table 3. LCA Results: Resource Use

LCA RESULTS - RESOURCE USE 1 M² PRELUDE XL					
Parameter	**Unit**	**A1. Raw materials**	**A2. Transport**	**A3. Production**	**A1-A3**
Use of renewable primary energy excluding renewable primary energy resources used as raw materials	MJ, net calorific value *	6.81E+02	1.31E+01	6.97E+02	1.39E+03
Use of renewable primary energy resources used as raw materials	MJ, net calorific value *	0.00E+00	0.00E+00	3.16E+01	3.16E+01
Total use of renewable primary energy resources (primary energy and primary energy resources used as raw materials)	MJ, net calorific value *	6.81E+02	1.31E+01	7.29E+02	1.42E+03
Use of nonrenewable primary energy excluding nonrenewable primary energy resources used as raw materials	MJ, net calorific value	2.80E+04	1.06E+03	4.24E+02	2.95E+04
Use of nonrenewable primary energy resources used as raw materials	MJ, net calorific value	0.00E+00	0.00E+00	6.79E+00	6.79E+00
Total use of nonrenewable primary energy resources (primary energy and primary energy resources used as raw materials)	MJ, net calorific value	2.80E+04	1.06E+03	4.31E+02	2.95E+04
Use of secondary material	metric ton	1.82E+02	0.00E+00	3.07E+01	2.13E+02
Use of renewable secondary fuels	MJ, net calorific value	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Use of non-renewable secondary fuels	MJ, net calorific value	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Use of net fresh water	m^3	4.24E+01	1.50E-01	3.07E-01	4.29E+01

* Net calorific value is applicable to combustible fuels and is not applicable to other forms of renewable energy (e.g. solar, wind)

4. LCA: Results (continued)

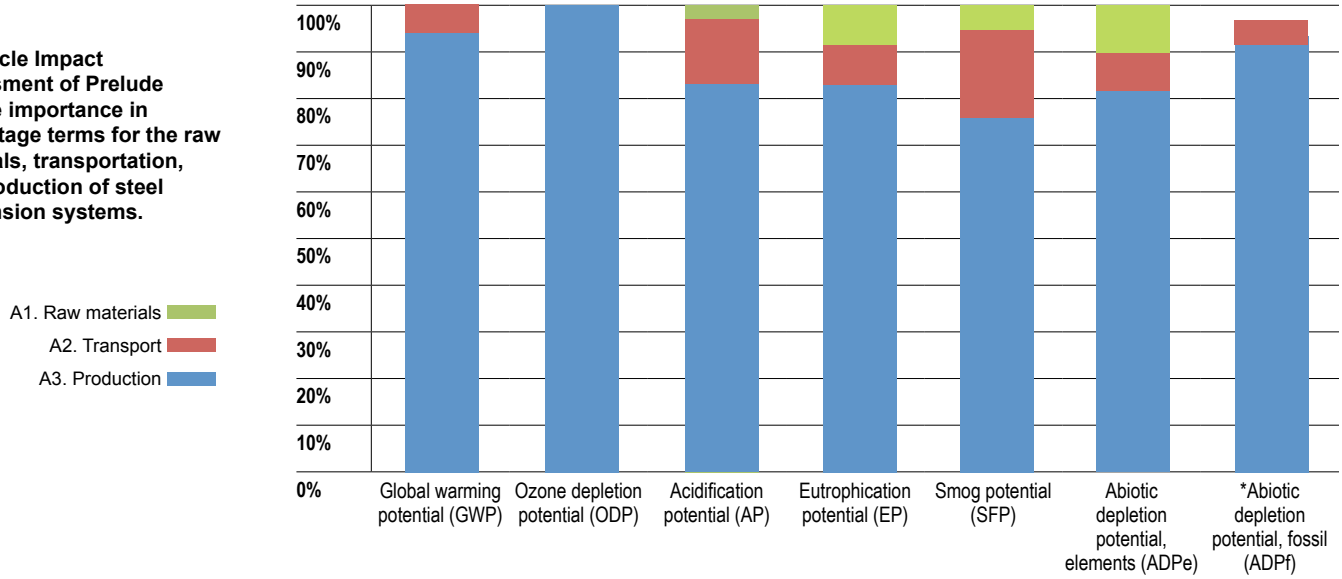
Table 4. LCA Results: Output Flows and Waste Categories

LCA RESULTS: OUTPUT FLOWS AND WASTE CATEGORIES 1 M² PRELUDE XL					
Waste:					
Parameter	**Reporting Unit**	**A1. Raw materials**	**A2. Transport**	**A3. Production**	**A1-A3**
Hazardous waste disposed	metric ton	NA	NA	NA	NA
Non-hazardous waste disposed	metric ton	NA	NA	NA	NA
Radioactive waste disposed	metric ton	NA	NA	NA	NA
Output Flow:					
Parameter	**Reporting Unit**	**A1. Raw materials**	**A2. Transport**	**A3. Production**	**A1-A3**
Components for re-use	metric ton	0	0	0	
Materials for recycling	metric ton	0	0	0.0332	0.0332
Materials for energy recovery	metric ton	0	0	0	
Exported energy	MJ per energy carrier	0	0	0.887	0.887

5. LCA: Interpretation

From the 2015 LCA study of Prelude steel suspension systems, it was concluded that the raw materials had the highest impact in all impact categories. Steel is the primary raw material and may account for 80-99% of the overall impact category.

Life Cycle Impact Assessment of Prelude relative importance in percentage terms for the raw materials, transportation, and production of steel suspension systems.



6. Supporting Documentation

Quality Assurance

Armstrong World Industries has a robust internal Quality Assurance process that is based on industry-accepted best practices. The process involves several hundred different measures made throughout the manufacturing processes. In addition, our products are UL labeled for fire, humidity, corrosion, and seismic performance, a process which involves strict oversight by Underwriters Laboratories.

7. References

PCR

UL Environment

UL Environment General Program Instructions April 2015, version 2

Sustainability Reporting Standards

EN 15804: 2012-04 - Sustainability of construction works — Environmental Product Declarations — Core rules for the product category of construction product.

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

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

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

ISO 14046:2013 – Environmental management- Water footprint- Principles, requirements and guidelines

ISO 15392:2008 – Sustainability in building construction- General principles

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

ISO 15686-2:2008 – Buildings and constructed assets- Service life planning Part 2: Service life prediction procedures

ISO 15686-7:2008 – 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

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

Relevant Federal Standards and SOPS

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

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

US 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

US: Resource Conservation and Recovery Act (RCRA), Clause C (http://www.epa.gov/region6/rcra/)

Relevant PCRs

North American Product Category Rule for Designated Steel Construction Products
by SCS Global Services, May 5, 2015 V.1.O

BPCS-5383-916