Biobased Tile (BBT™) with Diamond 10® Technology Coating

Striations BBT™ with Diamond 10® Technology Coating
Migrations® BBT™ with Diamond 10® Technology Coating

ACCORDING TO EN 15804, ISO 14025 AND ISO 21930

Armstrong® FLOORING

150+ Years of Excellence

Our founder, Thomas Armstrong, pioneered the principle "Let the buyer have faith," standing behind his products and giving customers confidence in their purchase. More than a century later, that philosophy is alive and well in Armstrong Flooring.

We are committed to delivering solutions that reduce the environmental impact of the buildings you create. From product design and raw material selection, to production and delivery, we work to demonstrate continuous improvement to remain as strong and vital as our 150-year heritage.

Inspired by nature and PVC-free, BBT™ is a sustainable flooring solution combining biophilic design, reduced maintenance, and long-term performance. With Diamond 10® Technology Coating, eliminate or reduce initial application of polish by 50% and reduce or eliminate ongoing restorative stripping and recoating.

Lifecyle Impact Categories

Cradle to grave environmental impacts for 1 m^2 of BBT™ with Diamond 10® Technology Coating

Primary Energy
101.7 MJ

Eutrophication Potential
1.04E-03 kg $(PO_4)^{3-}$-eq.

Global Warming Potential
4.55 kg CO_2-eq.

Ozone Depletion Potential
2.66E-09 kg R11-eq.

Acidification Potential
0.016 kg SO_2-eq.

Photochem Ozone Creation Potential
0.27 kg O_3-eq.

Flooring Components:

Limestone Flour, Biobased Polyester Resin, Titanium Dioxide, Colored Pigment

Inspiring Great Spaces®

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This document is a Type III Environmental Product Declaration by Armstrong Flooring, Inc. that is certified by ASTM as conforming to the requirements of ISO 14025, EN 15804 and ISO 21930. ASTM has assessed that the Life Cycle Assessment (LCA) information fulfills the requirements of ISO 14040 in accordance with the instructions listed in the product category rules cited below. The intent of this document is to further the development of environmentally compatible and sustainable construction methods by providing comprehensive environmental information related to potential impacts in accordance with international standards.

Declaration Number	EPD-0003
Program Operator	ASTM International - 100 Barr Harbor Drive, West Conshohocken, PA, 19428, USA www.astm.org
Manufacturer	Armstrong Flooring, Inc.- 2500 Columbia Avenue, Lancaster, PA 17603
Declared Product & Functional Unit	BBT™ with Diamond 10® Technology Coating, 1 m^2
Reference PCR	Part A: PCR for building-related products, 2018 Part B: Flooring EPD Requirements [UL Environment], v2.0 September, 2018
Product Application	Floor covering choice in commercial spaces: • Healthcare • Education • Retail • Hospitality • Office
Product Reference Service Life	25 Years
Markets of Applicability	North America
Date of Issue	December 20, 2019
Date of Validity	5 Years
EPD Type	Product Specific
EPD Scope	Cradle to Grave
Year of Primary Data	2017-2018
LCA Software & Version	GaBi v8.7.1.30
LCI Database(s) & Version	GaBi 2017
LCIA Method	TRACI 2.1

Verification and Authorization of the Declaration

This declaration and the rules on which this EPD is based have been examined by an independent external verifier in accordance with ISO 14025 and ISO 21930.

This life cycle assessment was independently verified in accordance with ISO 14044 and the reference PCR by:

X		X	
Tim Brooke Vice President, Certification	Date **December 20, 2019**	Thomas Gloria External Verifier	Date **December 20, 2019**

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2.0 Product Introduction

2.1 Company Description

Armstrong Flooring, Inc. (NYSE: AFI) is a global leader in the design and manufacture of innovative flooring solutions that inspire beauty wherever your life happens. Headquartered in Lancaster, Pennsylvania, Armstrong Flooring is a leading manufacturer of resilient products across North America. The company safely and responsibly operates 8 manufacturing facilities globally, working to provide the highest levels of service, quality and innovation to ensure it remains as strong and vital as its 150-year heritage. Learn more armstrongflooring.com.

2.2 Product Description

BBT™ with Diamond 10® Technology Coating is a biobased polyester composition floor tile. It's protected by a UV-cured, high-performance diamond-infused polyurethane, and the colors and pattern detail are dispersed uniformly throughout the thickness of the product. Diamond 10® Technology Coating provides ease of maintenance by eliminating or reducing initial application of polish by 50% and reducing or eliminating ongoing restorative stripping and recoating.

2.2.1 Brands

Striations BBT™ with Diamond 10® Technology Coating
Migrations® BBT™ with Diamond 10® Technology Coating

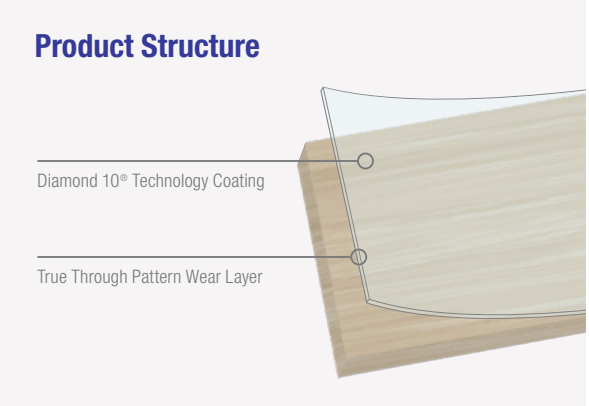
2.2.2 Specifications

All Armstrong BBT™ meets or exceeds the performance requirements of ASTM F 2982 Polyester composition floor tile through pattern.

2.2.3 Product Specific EPD

This EPD Is intended to represent product specific life cycle assessment results for the Armstrong Flooring BBT™ tile brands in Section 2.2.1.

Figure 1. Example product structure for BBT™ with Diamond 10® Technology Coating



2.3 Application

BBT™ is a widely used commercial resilient flooring option and is routinely used with great success in the healthcare and education segments. Properly installed and maintained, BBT™ provides decades of proven performance across all commercial segments.

2.4 Declaration of Methodological Framework

The Life Cycle Assessment (LCA) was performed according to ISO 14040 and followed the PCR instructions. The cradle-to-grave LCA encompasses all relevant life cycle stages and modules including raw material production; transport of raw materials to the production facility; manufacturing of flooring; packaging; transportation to job site; use phase; and end of life including disposal or recycling. Detailed information regarding cut-off and allocation procedures are in sections 2.5 and 2.9.

2.5 Technical Data

Table 1: BBT™ Technical Data

BBT™	AVERAGE VALUE	UNIT	MIN. VALUE	MAX. VALUE
Product Thickness	3.2 (0.125)	mm (in.)	–	–
Wear Layer Thickness	3.2 (0.125)	mm (in.)	–	–
Product Weight	7030 (1.4)	g/m² (lbs.)	–	–
Product Form Tile			305 mm x 305 mm	305 mm x 610 mm

2.6 Market Placement / Application Rules

BBT™ with Diamond® 10 Technology Coating meets or exceeds the performance requirements of ASTM F 2982, Standard Specification for Polyester Composition Floor Tile. It meets the below performance requirements for the following test methods:

Table 2: BBT Performance and Test Methods

	PERFORMANCE	TEST METHOD	REQUIREMENT	PERFORMANCE VS. REQUIREMENT
ASTM F2982	Thickness	ASTM F 386	Nominal ± 0.005 in	Meets
	Size	ASTM F 2055	± 0.016 in. per linear foot	Meets
	Squareness	ASTM F 2055	0.010 in. max	Meets
	Indentation – One Minute	ASTM F 1914	≤ 0.012 in.	Meets
	Indentation – Ten Minutes	ASTM F 1914	≤ 0.015 in.	Meets
	Impact	ASTM F 1265	No cracks beyond limit after 12 drops	Meets
	Deflection	ASTM F 1304	1.0 in. minimum	Meets
	Dimensional Stability	ASTM F 2199	≤ 0.028 in. per linear foot max.	Meets
	Chemical Resistance	ASTM F 925	No more than slight change in surface dulling, attack or staining	Meets
	Resistance to Light	ASTM F 1515	ΔE not greater than 8.0	Meets
	Resistance to Heat	ASTM F 1514	ΔE not greater than 8.0	Meets
	Static Load Resistance @ 250 psi	ASTM F 970	≤ 0.005 in.	Meets
Additional Testing	Static Load Resistance	ASTM F 970*	≤ 0.005 in.	2000 psi
	Fire Test Data – Flame Spread	STM E 648	0.45 W/cm² or more Class I	Meets
	Fire Test Data – Smoke Evolution	ASTM E 662	450 or less	Meets
	Fire Test Data – Canada	CAN/ULC S-102.2	Use dependent	Flame Spread - 0 Smoke Developed - 5
	Acoustics	ASTM E2179	Sound transmission reduction	Meets – Delta IIC (ΔIIC) – 6
	ADA Standards for Accessible Design	Chapter 3 Section 302.1	Floor surfaces shall be stable, firm and slip-resistant	Meets
	Static Coefficient of Friction**	ASTM D 2047/UL 410	≥ 0.5	Meets

* Testing at loads above 250 psi is outside the scope of the test method. Since testing is conducted on uninstalled flooring, results do not consider the performance of the adhesive, underlayment, or subfloor. These test results are not an indicator of the installed flooring system performance.

** Using the James Machine as described in D2047 and as directed in UL 410 for floor covering materials (FCM) using a leather foot under dry conditions. The application of site-applied floor sealers, polishes and other types of finishes routinely used to maintain resilient flooring materials will change the walking surface and consequently the SCOF value.

2.7 Material Composition

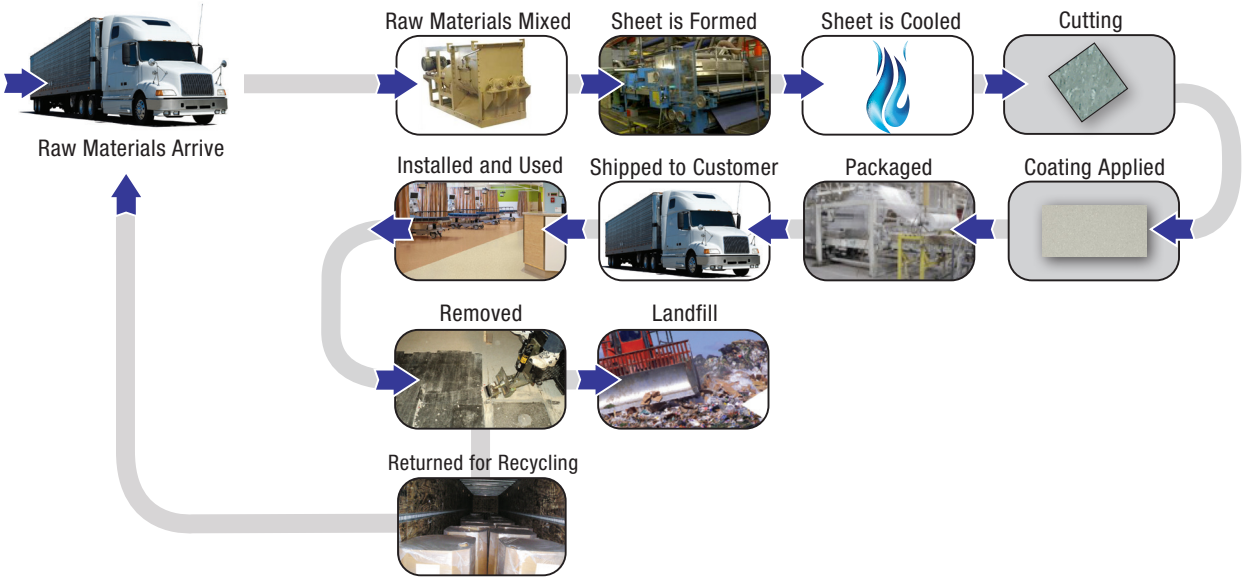
Table 3: Material Composition for BBT™ with Diamond® 10 Technology Coating

MATERIAL CONTENT	FUNCTION	CASRN	QUANTITY (% BY WEIGHT)		AVAILABILITY	
			BBT™	BBT™ WITH DIAMOND 10® TECHNOLOGY COATING		
Limestone Flour	Filler	1317-65-3	85-88%	85-88%	Abundant Mineral	Non-Renewable
Biobased Polyester Resin	Binder	N/A	11-14%	11-14%	Biobased Crop	Renewable
					Fossil Limited	Non-Renewable
Pigments	Titanium Dioxide	13463-67-7	0.1-.5%	0.1-.5%	Abundant Mineral	Non-Renewable
	Colored Pigment	various	<0.1%	<0.1%	Abundant Mineral	Non-Renewable

2.8 Manufacturing

BBT™ is floor tile primarily used in commercial flooring applications and is comprised mostly of limestone in a biobased polyester matrix. The manufacturing process involves the hot mixing of the raw materials milled and calendered into a hot sheet that is then cooled before cutting into floor tiles. Diamond 10® Technology coating is added to each tile and the tiles are sent to packaging.

Figure 2: Process for Manufacturing BBT™ with Diamond 10® Technology Coating



2.9 Packaging

BBT™ with Diamond 10® Technology Coating is packaged in a recyclable corrugated box and placed on a wooden pallet for shipping.

2.10 Installation

BBT™ with Diamond 10® Technology Coating must be installed in strict accordance with the Armstrong Flooring Guaranteed Installation Systems manual, F-5061. This comprehensive guide to Armstrong Flooring installation provides all the information needed to properly install BBT™ with Diamond 10® Technology coating to ensure it will look great and perform exactly as it should. Visit armstrongflooring.com/commercial for more information.

2.11 Use Conditions

Recommended maintenance practices are provided in the installation guide and are required as part of the warranty. Warranty details can be found at armstrongflooring.com/commercial. For BBT™ with Diamond 10® Technology Coating, the recommended maintenance is representative of medium intensity maintenance, as shown in Table 6. Because maintenance procedures often vary depending on the building owner's maintenance practices, level of use, and traffic conditions, Table 6 provides low, medium and high maintenance scenarios. The low intensity maintenance scenario results in lower environmental impacts. For example, less scrubbing means less water consumption and a lower eutrophication potential.

2.12 Reference Service Life & Estimated Building Service Life

Per the PCR, this product has a 25 year reference service life and is intended for a building with a 75-year estimated service life.

2.13 Reuse, Recycling & Energy Recovery

BBT™ with Diamond 10® Technology coating can be recycled through the On&On® Recycling Program provided it meets program requirements. See www.armstrongflooring.com/reclaim

2.14 Disposal

At the end of life, this product is assumed to be disposed per PCR requirements (UL, 2018) as shown in Table 4. Waste classification is based on the Resource Conservation and Recovery Act. Disposal in municipal landfill or commercial incineration facilities is permissible and should be done in accordance with local, state, and federal regulations.

Table 4: End of Life Assumptions

COMPONENT	RECYCLED	LANDFILLED	INCINERATED
Product	0%	100%	0%
Paper Packaging	75%	20%	5%

2.15 Further Information

Please visit www.armstrongflooring.com/commercial for additional information regarding BBT™ with Diamond 10® Technology Coating.

3.1 Functional Unit

The functional unit for this EPD is 1 m^2 of 2.0 mm BBT™ with Diamond 10® Technology Coating for use over one year. Flooring System View: In order to understand the complete view of a flooring system, life cycle information is included for the total flooring system based on one square meter (m^2) view. This includes the flooring, adhesives and finishes applied during the use stage.

3.2 System Boundaries

The system boundaries studied as part of this life cycle assessment include the following stages which are shown in Table 4:

Production stage – Modules A1 to A3 which include the extraction manufacture and transportation of raw materials flooring production.

Construction Stage – Modules A4-A5 which include the transportation to job site and installation.

Use Stage – Includes on Modules B2 (Use) and B4 (Replacement) as the other modules B1, B3 and B5-B7 are declared as having zero impact as no repair or refurbishment is expected once the product is installed. The use stage accounts for cleaning of the floor.

End-of-Life – Modules C1-C4 which include disposal

Each module includes provisions of all relevant materials, products and energy. Potential impacts and waste are consider in the module in which they occur. Per the PCR, capital goods and infrastructure flows are assumed to not significantly affect LCA results or conclusions and thus are excluded from the analysis.

Table 5: Construction Works Assessment Information

PRODUCTION STAGE			CONSTRUCTION STAGE		USE STAGE							END-OF-LIFE STAGE			
Extraction & Upstream Production A1	Transport to Factory A2	Manufacturing A3	Transport to Site A4	Installation A5	Use B1	Maintenance B2	Repair B3	Replacement B4	Refurbishment B5	Operational Energy Use B6	Operational Water Use B7	De-construction / Demolition C1	Transport to waste processing or Disposal C2	Waste Processing C3	Disposal C4
X	X	X	X	X		X		X				X	X	X	X

3.3 Product for Use Phase (Module B1-B7)

For this study, it was assumed that BBT™ with Diamond 10® Technology Coating would last 25 years and therefore would need to be replaced 2 times over the building's useful life if properly installed and maintained. The useful life indicated in the PCR for flooring is 75 years. Recommended maintenance practices are provided in the Armstrong Flooring Installation Guide and required as part of the warranty. Warranty details can be found at Armstrongflooring.com/commercial. For BBT™ with Diamond 10® Technology Coating, the recommended maintenance is representative of medium intensity maintenance, as shown in Table 6. Because maintenance procedures often vary depending on the building owner's maintenance practices, level of use, and traffic conditions, Table 6 provides low, medium and high maintenance scenarios. The normalized environmental impacts associated with these hypothetical scenarios are shown in Figure 3. The low intensity maintenance scenario results in lower environmental impacts. For example, less scrubbing means less water consumption and a lower eutrophication potential.

Table 6: Estimated Maintenance Intensity & Assumptions

MAINTENANCE SCHEDULE	NUMBER OF TIMES PERFORMED IN 1 YEAR (365 DAYS)			ADDITIONAL RESOURCE CONSUMPTION
	LOW	MEDIUM	HIGH	
Sweep/Dry Mop	260	260	260	None
Damp Mop	26	52	104	Water, pre-diluted cleaner
Scrubbing/Spray Buff	6	12	24	Floor finish, electricity
Stripping/Floor Finish	0	1	2	4

3.4 Units

The PCR require SI units for all LCA results.

3.5 Estimations and Assumptions

Transportation

Per the PCR (UL, 2018) a distance of 800 km (497 miles) by diesel-powered truck is used to represent the distribution of product to the installation site. For products manufactured outside of the United States, inbound transportation by cargo ship is also included. Additionally, transportation is assumed to be 161 km (100 miles) by diesel-powered truck for the following:

- Product to building site
- Installation waste to disposal
- Deconstructed product to end of life destination

3.6 Cut-off Rules

Cut-off rules are consistent with PCR (UL, 2018). No known flows were deliberately excluded.

3.7 Data Sources

All gate-to-gate, primary foreground data was collected for the flooring manufacturing process. This foreground data was from annual production for the year of 2017. Relevant background data was taken from the database provided in the GaBi 8.7.1.30 software system for life cycle engineering. The GaBi database provides the life cycle inventory data for the raw and process materials obtained from the background system.

3.8 Data Quality

A variety of tests and checks were performed throughout the project to ensure high quality of the completed LCA. Checks included data verification and triangulation against several sources including published LCA studies. Overall, the data quality is considered to be good to high quality.

Temporal: All of the primary data is taken from 12 months of continuous operation in the 2017 calendar year. All secondary data were obtained from the GaBi 2018 databases.

Geographical: All primary and secondary data were collected specific to the countries or regions under study. Where country-specific or region-specific data were unavailable, proxy data were used. Geographical representativeness is considered to be high.

Technological: All primary and secondary data were modeled to be specific to the technologies or technology mixes under study. Where technology-specific data were unavailable, proxy data were used. Technological representativeness is considered to be high.

3.9 Period under review

Primary data was collected during 2018. This analysis is intended to represent production in 2017.

3.10 Allocation

No co-product or multi-input process allocation occurs in the product system. For reuse, recycling, and recovery allocation, the cut-off allocation approach is adopted in the case of any recycled content, which is assumed to enter the system burden-free. Only environmental impacts from the point of recovery and forward (e.g., collection, sorting, processing, etc.) are considered. With the exception of bio-based packaging waste, product and packaging waste is modeled as being disposed in a landfill rather than incinerated or recycled. Plastic and other construction waste is assumed to be inert in landfills so no system expansion or allocation is necessary as landfill gas is not produced. In the case of biobased packaging waste disposed during installation, landfill gas from the decomposition of this waste is assumed to be collected and used to produce electricity. It is assumed that this recovered energy offsets energy produced by the U.S. average grid.

3.11 Comparability and Benchmarking

This EPD compares standard BBT™ to BBT™ with Diamond® 10 Technology Coating, which is manufactured in the United States. These results are comparable and acceptable according to the PCR and ISO standards, because background datasets, modeling assumptions, and time periods are the same.

Life Cycle Assessment Scenarios

The following information is required by the PCR to be documented.

Table 7: Transportation to the Building Site (A4)

NAME	VALUE	UNIT
Fuel Type	Diesel	–
Liters of Fuel	35	L/100km
Vehicle Type	Truck (trailer)	–
Transportation Distance	800	km
Capacity Utilization (including Empty Runs, Mass Based)	78	%
Gross Density of Products Transported	2.1	kg/m²
Capacity Utilization Volume Factor	1	–

Table 8: Installation into the Building (A5)

NAME	VALUE	UNIT
Ancillary Materials	0.37	kg
Electricity Consumption	0.02	MJ
Waste Materials at the Construction Site	0.26	kg

Table 9: Reference Service Life

NAME	VALUE	UNIT
Reference Service Life	25	years

Table 10: Maintenance (B2)

NAME	VALUE	UNIT
Maintenance Process Information (Cite Source)	AFI Maintenance Guide	
Maintenance Cycle (Reference Service Life)	1,560 (weekly)	Cycles/RSL
Maintenance Cycle (Estimated Service Life)	3,900 (weekly)	Cycles/ESL
Net Freshwater Consumption: Municipal Water to POTW	0.11	kg/ESL
Ancillary Materials (Pre-diluted Cleaner)	306.7	L/ESL
Energy Input for Spray Buffing	5.67	kWh/ESL

Table 11: Replacement (B4)

NAME	VALUE	UNIT
Reference Service Life	30	Years
Replacement Cycle	1.5	–
Ancillary Materials (Adhesive)	0.56	kg
Electricity Consumption	0.03	MJ
Waste Materials at the Construction Site	0.39	kg

Table 12: End of Life (C1-C4)

NAME	DESCRIPTION	VALUE	UNIT
Collection Process	Collect Separately	3.3	kg
Disposal	Product or Materials for Final Disposition	3.3	kg

4.0 Life Cycle Assessment Results

The results in this EPD represent product specific results for one square meter of Armstrong Flooring products. Caution should be used when trying to compare the results presented in this EPD to other products.

4.1 Life Cycle Assessment Impact Results

Results for the life cycle assessment are presented in the tables below. The Product Category Rules for Flooring require impacts be calculated for a building life of 75 years. This means that during a 75 year time frame, the floor is manufactured, installed, maintained, and replaced multiple times depending upon the floor's reference service life. The estimated reference service life for the BBT product is provided in Table 9. The total 75-year impacts are calculated by adding the values from all of the modules plus 74 times the impact value shown in B2 module. Additionally, impacts for a 1-year service life including disposal are shown in the tables below.

Table 13: Impact Assessment Results for 1m² of BBT™

BBT™	TRACI 2.1 IMPACT CATEGORY	Global Warming Air, incl. Biogenic Carbon	Ozone Depletion Air	Acidification	Eutrophication	Smog Air	Resources, Fossil Fuels
	UNITS	kg CO2 eq.	kg CFC 11 eq.	kg SO2 eq.	kg N eq.	kg O3 eq.	MJ
Production	A1-A3	2.94	1.73E-12	6.16E-03	5.14E-04	0.13	7.27
Transport	A4	0.71	-3.81E-15	3.39E-03	2.81E-04	0.08	1.34
Install	A5	0.43	2.66E-09	4.54E-03	8.50E-05	0.02	2.01
Maintain	B2	0.30	-1.98E-14	6.22E-04	1.19E-04	0.01	0.77
Replace	B4	9.030	5.32E-09	3.22E-02	2.01E-03	0.536	22.928
Transport	C2	0.146	-7.80E-16	6.99E-04	5.77E-05	0.016	0.274
Disposal	C4	0.288	-1.49E-14	1.30E-03	6.63E-05	0.026	0.568
Recycling	D	0	0	0	0	0	0
	75 YEARS	36.046	0.000	0.095	0.012	1.660	92.067
	1 YEAR	4.82	2.66E-09	0.017	1.12E-03	0.28	12.23

Table 14: Impact Assessment Results for 1m² of BBT™ with Diamond 10® Technology Coating

BBT™ WITH DIAMOND 10® TECHNOLOGY COATING	TRACI 2.1 IMPACT CATEGORY	Global Warming Air, incl. Biogenic Carbon	Ozone Depletion Air	Acidification	Eutrophication	Smog Air	Resources, Fossil Fuels
	UNITS	kg CO2 eq.	kg CFC 11 eq.	kg SO2 eq.	kg N eq.	kg O3 eq.	MJ
Production	A1-A3	2.94	4.38E-13	6.15E-03	5.13E-04	0.125	7.27
Transport	A4	0.70	-3.81E-15	3.39E-03	2.81E-04	0.078	1.34
Install	A5	0.39	2.66E-09	4.45E-03	7.78E-05	0.022	1.87
Maintain	B2	0.08	-4.07E-15	2.00E-04	4.89E-05	3.72E-03	0.25
Replace	B4	8.944	0.000	0.032	0.002	0.533	22.644
Transport	C2	0.146	-7.80E-16	6.99E-04	5.77E-05	0.016	0.274
Disposal	C4	0.288	-1.49E-14	1.30E-03	6.63E-05	0.026	0.568
Recycling	D	0	0	0	0	0	0
	75 YEARS	19.366	7.99E-09	0.063	0.007	1.078	52.586
	1 YEAR	4.55	2.66E-09	0.016	1.04E-03	0.27	11.57

4.2. Life Cycle Inventory Results

Tables 14 and 15 provide life cycle inventory results for products included in this EPD. Inventory data are are not included for non-renewable primary energy resources used as raw materials, use of secondary materials (SM), use of renewable secondary fuels (RSF), or use of non-renewable secondary fuels (NRSF) as values for these inventory categories are zero.

Table 15: Resources Use for 1 m² of BBT™

BBT™	RESOURCE USE PARAMETERS	Total use of renewable primary energy resources	Renewable primary energy used as energy carrier	Total use of non-renewable primary energy resources	Non-renewable primary energy used as energy carrier	Use of net fresh water resources (FW)
	UNITS	[MJ, LHV]	[MJ, LHV]	[MJ, LHV]	[MJ, LHV]	[m³]
Production	A1-A3	5.18	5.18	60.88	60.88	1.00E-02
Transport	A4	0.31	0.31	10.80	10.80	1.21E-03
Install	A5	0.10	0.10	15.90	15.90	1.49E-03
Maintain	B2	0.31	0.31	7.01	7.01	-3.73E-03
Replace	B4	9.47	9.47	152.54	152.54	1.96E-02
Transport	C2	0.06	0.06	2.21	2.21	2.47E-04
Disposal	C4	0.34	0.34	4.89	4.89	5.37E-04
Recycling	D	0.00	0.00	0.00	0.00	0.00E+00
	1 YEAR	6.32	6.32	101.69	101.69	9.80E-03
	75 YEARS	38.95	38.95	772.97	772.97	-0.25

Table 16: Resources Use for 1 m² of BBT™ with Diamond 10® Technology Coating

BBT™ WITH DIAMOND 10® TECHNOLOGY COATING	RESOURCE USE PARAMETERS	Total use of renewable primary energy resources	Renewable primary energy used as energy carrier	Total use of non-renewable primary energy resources	Non-renewable primary energy used as energy carrier	Use of net fresh water resources (FW)
	UNITS	[MJ, LHV]	[MJ, LHV]	[MJ, LHV]	[MJ, LHV]	[m³]
Production	A1-A3	5.17	5.17	60.88	60.88	1.00E-02
Transport	A4	0.31	0.31	10.80	10.80	1.21E-03
Install	A5	0.08	0.08	14.76	14.76	1.17E-03
Maintain	B2	0.06	0.06	2.10	2.10	-2.17E-03
Replace	B4	9.08	9.08	143.48	143.48	1.65E-02
Transport	C2	0.15	0.15	2.21	2.21	2.47E-04
Disposal	C4	0.29	0.29	4.89	4.89	5.37E-04
Recycling	D	0.00	0.00	0.00	0.00	0.00E+00
	1 YEAR	6.05	6.05	95.65	95.65	0.01
	75 YEARS	19.33	19.33	394.52	394.52	-0.13

Table 17: Outflows and Waste Categories for 1 m² of BBT™

BBT™	OUTFLOWS AND WASTE CATEGORIES	Harardous Waste Disposed (HWD)	Non-Harardous Waste Disposed (NHWD)	High Level Radioactive Waste Disposed (HLRW)	Intermediate Low Level Radioactive Waste (ILLRW)	Exported Energy, Electrical	Exported Energy, Thermal
	UNITS	kg	kg	kg	kg	[MJ, LHV]	[MJ, LHV]
Production	A1-A3	1.17E-05	2.43E-01	-9.17E-07	-7.46E-04	0	0
Transport	A4	8.14E-08	3.79E-04	-2.68514E-08	-2.17575E-05	0	0
Install	A5	7.62E-09	4.82E-01	-4.29054E-08	-3.48387E-05	0.000106	4.99E-05
Maintain	B2	5.76E-09	1.02E-02	-2.003E-07	-0.000163001	0	0
Replace	B4	2.37E-05	1.44E+01	-2.49469E-06	-0.002025508	0.000212	9.98E-05
Transport	C2	1.67E-08	7.76E-05	-5.5017E-09	-4.45799E-06	0	0.00E+00
Disposal	C4	1.58E-08	6.47E+00	-5.50178E-08	-4.28988E-05	0	0
Recycling	D	0.00E+00	0.00E+00	0	0	0	0
	1 YEAR	1.19E-05	7.20E+00	-1.24735E-06	-1.01E-03	0.000106	4.99E-05
	75 YEARS	3.60E-05	2.24E+01	-1.86E-05	-1.51E-02	0.000318	1.50E-04

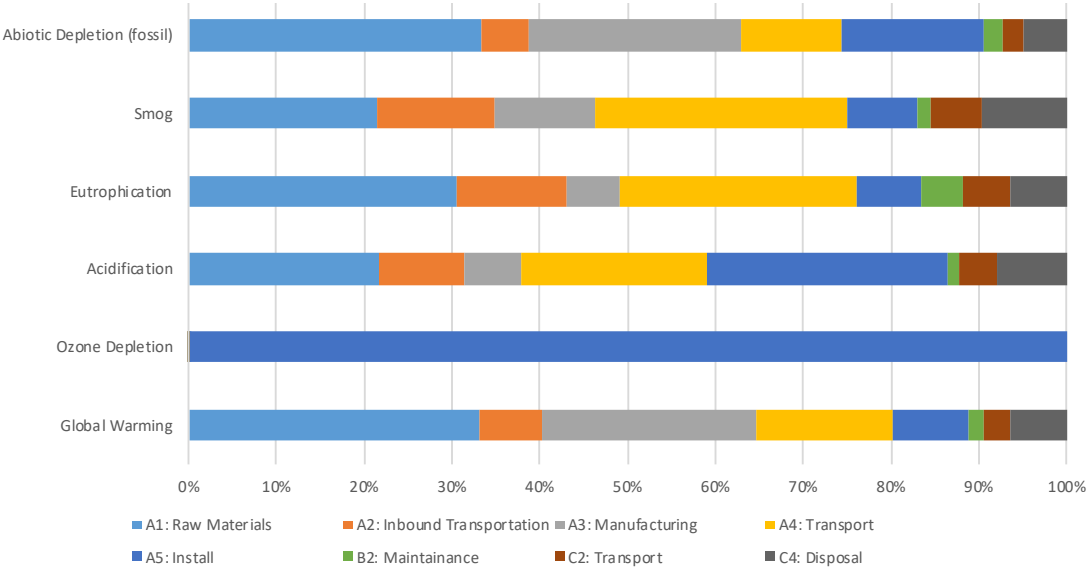
Table 18: Outflows and Waste Categories for 1 m² of BBT™ with Diamond 10® Technology Coating

BBT™ WITH DIAMOND 10® TECHNOLOGY COATING	OUTFLOWS AND WASTE CATEGORIES	Harardous Waste Disposed (HWD)	Non-Harardous Waste Disposed (NHWD)	High Level Radioactive Waste Disposed (HLRW)	Intermediate Low Level Radioactive Waste (ILLRW)	Exported Energy, Electrical	Exported Energy, Thermal
	UNITS	kg	kg	kg	kg	[MJ, LHV]	[MJ, LHV]
Production	A1-A3	7.75E-06	2.43E-01	-9.17E-07	-7.45E-04	0	0
Transport	A4	6.79E-09	4.82E-01	-2.44301E-08	-1.97668E-05	0	0
Install	A5	2.01E-09	2.90E-03	-3.48726E-08	-2.84432E-05	0.000331	1.56E-04
Maintain	B2	1.67E-08	7.76E-05	-5.50249E-09	-4.45862E-06	0	0
Replace	B4	1.56E-05	1.44E+01	-2.08384E-06	-0.001690411	0.000662	3.12E-04
Transport	C2	1.67E-08	7.76E-05	-5.50249E-09	-4.45862E-06	0	0
Disposal	C4	1.58E-08	6.47E+00	-5.50256E-08	-4.29049E-05	0	0
Recycling	D	0.00E+00	0.00E+00	0	0	0	0
	1 YEAR	7.81E-06	7.20E+00	-1.04192E-06	-8.45E-04	0.000331	1.56E-04
	75 YEARS	2.47E-05	2.16E+01	-3.53E-06	-2.87E-03	0.000993	4.68E-04

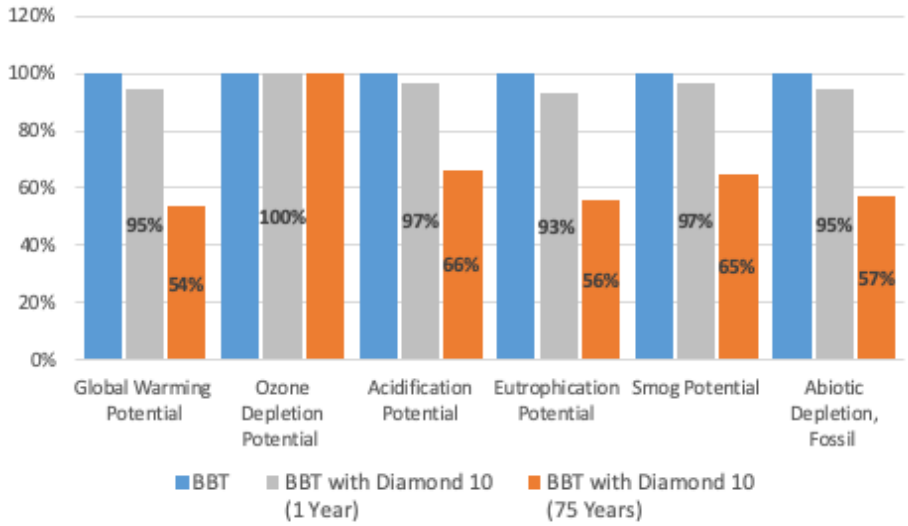
5.0 LCA Interpretation

Under the 75-year building service life assumption, product manufacturing (A1-A3) and recommended maintenance (B2) are the largest contributors to most impacts categories considered. The production of raw materials as shown in Figure 4, represents a substantial fraction of potential impact, even over the life of a building. The potential impact of floor maintenance adds up over time and are relevant contributors to the life cycle. Transportation of the flooring product from the manufacturing facility to the installation site (A4) is a relatively minor contributor to all impact categories. Replacement (B4) is a key contributor, because it represents the production (A1-A3), installation (A5) and disposal of replacement products (B4) needed to satisfy the 75-year building service. The PCR assumes that all flooring product have the same durability, however more durable products will have lower impact.

Figure 3. One-Year Life Cycle Impacts for BBT™ Sheet with Diamond 10® Technology Coating



When BBT is compared with BBT with Diamond 10® Technology coating, an impact reduction is seen in the categories shown in Figure 4 except ozone depletion potential. The impact reduction in the first year is small, 3-7% depending on impact categories during the first year. But, these impacts when compounded over the life of the building result in impact reductions from 34-46%.



6.0 Additional Environmental Information

The PCR assumes that all flooring product have the same durability, however more durable products will have lower impact.

6.1 Environment and Health During Manufacturing

All Armstrong Flooring manufacturing plants maintain an Environmental Management System (EMS) in accordance with ISO 14001 which includes continuous environmental performance targets. Manufacturing plants located outside of the United States including plants in China and Australia are third party certified to ISO 14001 and ISO 9001.

Additionally, Armstrong 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.

6.2 Environment and Health During Installation and Use.

All Armstrong flooring products are tested and certified by FloorScore® to comply with the requirements of the California Department of Public Health Standard for the Testing and Evaluation of VOC emissions (CDPH v1.2).

7.0 References

Armstrong Flooring (2018), Guaranteed Installation Systems (F-5061) manual.

CDPH. (2017) Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers – v1.2.

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

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

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

ISO. (2015) 9001: Quality Management Systems – Requirements.

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

European Standards. (2013) EN 15804+A1 Sustainability of construction works – Environmental product declarations – Core rules for the product category of construction products.

UL (2018) Product Category Rules for Building-Related products and Services in North America – Part A, v 3.2.

UL (2018) Product Category Rules for Building-Related Products and Services, Part B: Flooring EPD Requirements, v 2.0.

US EPA. (2012) Tool for the reduction and assessment of Chemical and other Environmental Impacts (TRACI) v 2.1.