# Vinyl Composition Tile (VCT)

Premium Excelon®
Standard Excelon®
Safety Zone™ Tile
Excelon® SDT™

ACCORDING TO EN 15804, ISO 10425 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.**

Armstrong Vinyl Composition Tile (VCT) is limestone-based flooring tiles with a PVC binder, featuring a through-pattern construction. 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 VCT with Diamond 10® Technology coating flooring assuming a 1-year service life.

**Primary Energy**
121.92 MJ

**Eutrophication Potential**
1.20E-03 kg $(PO_4)^{3-}$-eq.

**Global Warming Potential**
5.20 kg $CO^2$-eq.

**Ozone Depletion Potential**
2.83E-09 kg R11-eq.

**Acidification Potential**
0.02 kg $SO^2$-eq.

**Photochem Ozone Creation Potential**
0.30 kg $O^3$-eq.

## Flooring Components:

Limestone Flour, Polyvinyl chloride (PVC), Dioctyl Terephthalate (DOTP), Blended Dibenzoates, Recycled Material, Acrylate, Pigments


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# Vinyl Composition Tile (VCT)

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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-0001 |
| **Program Operator** | ASTM International - 100 Barr Harbor Drive, West Conshohocken, PA, 19428, USA<br>www.astm.org |
| **Manufacturer** | Armstrong Flooring, Inc.- 2500 Columbia Avenue, Lancaster, PA 17603 |
| **Declared Product & Functional Unit** | Vinyl Composition Tile, 1 $m^2$ |
| **Reference PCR** | Part A: PCR for building-related products, 2018<br>Part B: Flooring EPD Requirements [UL Environment], v2.0 September, 2018 |
| **Product Application** | Floor covering choice in commercial spaces:<br>• Healthcare<br>• Education<br>• Retail<br>• Hospitality<br>• 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 and EN15805. | | This life cycle assessment was independently verified in accordance with ISO 14044 and the reference PCR by: | |
|---|---|---|---|
| X | | X | |
| Tim Brooke<br>Vice President, Certification | Date<br>**December 20, 2019** | Tom Gloria<br>External Verifier | Date<br>**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 at armstrongflooring.com.

## 2.2 Product Description

Armstrong Vinyl Composition Tile (VCT) is limestone-based flooring tiles with a PVC binder, featuring a through-pattern construction. After years of foot and rolling load traffic, the pattern of the flooring is preserved; wear is less visible and can be restored using simple maintenance methods. With Diamond 10® Technology coating, eliminate or reduce initial application of polish by 50% and reduce or eliminate ongoing restorative stripping and recoating.

### 2.2.1 Brands

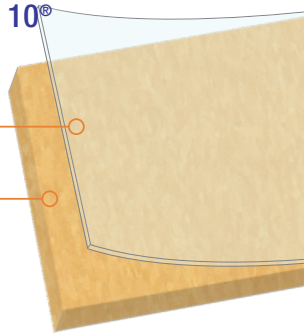
Premium Excelon®

Standard Excelon®

Safety Zone™ Tile

Excelon® SDT™

**Figure 1. Example product structure for VCT with Diamond 10® Technology coating**




### 2.2.2 Specifications

Armstrong Flooring VCT meets or exceeds the performance requirements of ASTM F1066, Standard Specification for Vinyl Composition Tile

### 2.2.3 Product Specific EPD

This EPD is intended to represent product specific life cycle assessment results for the Armstrong Flooring VCT brands in Section 2.2.1.

## 2.3 Application

VCT is a widely used commercial resilient flooring option and is routinely used with great success in healthcare, education, and retail segments. Properly installed and maintained, VCT 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 is in section 3.6.

## 2.5 Technical Data

### Table 1: Armstrong Flooring VCT Technical Data

| ARMSTRONG FLOORING VCT WITH DIAMOND 10® TECHNOLOGY COATING | | 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 | $g/m^2$ | – | – |
| Product Form | Tile | – | – | 305 mm x 305 mm | 305 mm x 610 mm |

## 2.6 Market Placement / Application Rules

All Armstrong VCT meets or exceeds the performance requirements of ASTM F1066, Standard Specification for Vinyl Composition Floor Tile. It meets the below performance requirements for the following test methods:

### Table 2: Performance and Test Methods for VCT

| | PERFORMANCE | TEST METHOD | REQUIREMENT | PERFORMANCE VS. REQUIREMENT |
|---|---|---|---|---|
| ASTM F 1066 | 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 | ≥ 0.006 in. to ≤ 0.015 in. | Meets |
| | Indentation @ 115°F | ASTM F 1914 | < 0.032 in. | Meets |
| | Impact | ASTM F 1265 | No cracks beyond limit | Meets |
| | Deflection | ASTM F 1304 | 1.0 in. minimum | Meets |
| | Dimensional Stability | ASTM F 2199 | ≤ 0.024 in. per linear foot | Meets |
| | Chemical Resistance | ASTM F 925 | No more than slight change in surface dulling, attack or staining | Meets |
| | Resistance to Heat | ASTM F 1514 | ΔE not greater than 8.0 | Meets |
| | Static Load Limit @ 125 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 | ASTM E 648 | 0.45 W/cm$^2$ or more Class I | Meets |
| | Fire Test Data – Smoke Evolution | ASTM E 662 | 450 or less | Meets |
| | Fire Test Data – Canada | CAN\ULC S102.2 | Use dependent | Flame Spread - 0 Smoke Developed - 5 |
| | ADA Standards for Accessible Design | ADA Standards for Accessible Design | Floor surfaces shall be stable, firm and slip-resistant | Meets |
| | Static Coefficient of Friction* | ASTM D2047/ UL 410 | ≥ 0.5 | Meets |

* Testing at loads above 125 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

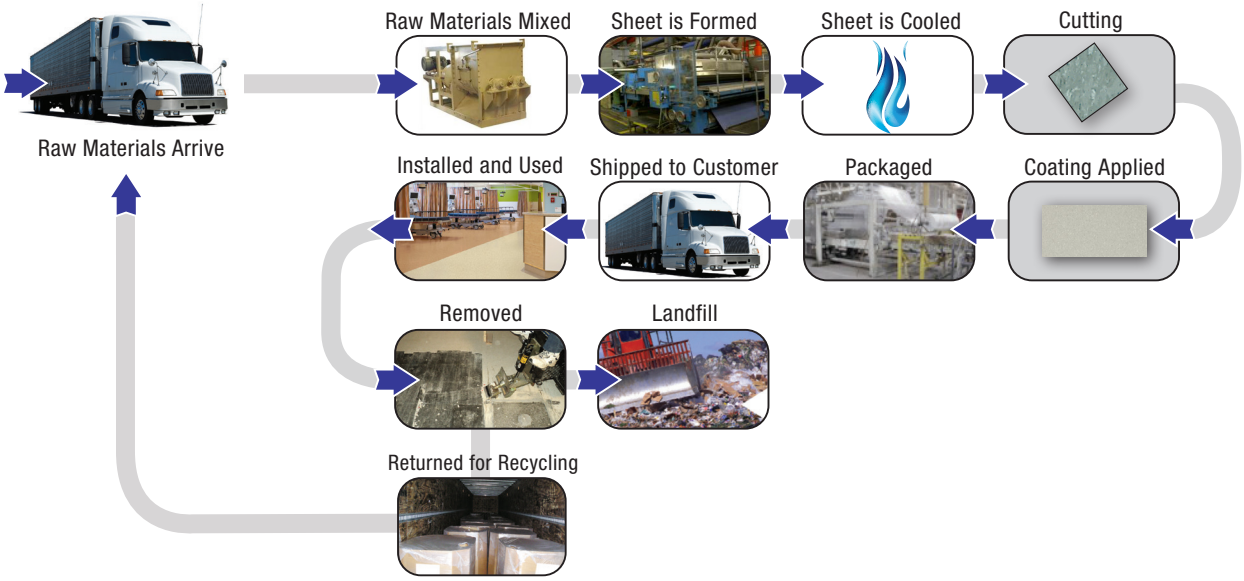
### Table 3: Material Composition for Armstrong VCT

| MATERIAL CONTENT | FUNCTION | CASRN | QUANTITY (% BY WEIGHT) | | AVAILABILITY | |
|---|---|---|---|---|---|---|
| | | | VCT | VCT™ WITH DIAMOND 10® TECHNOLOGY COATING | | |
| Limestone Flour | Filler | 1317-65-3 | 80-85% | 80-85% | Abundant Mineral | Non-Renewable |
| Polyvinyl Chloride (PVC) | Binder/Film | 9002-86-2<br>9003-22-9 | 5-10% | 5-10% | Fossil Limited | Non-Renewable |
| Dioctyl Terephthalate (DOTP) | Plasticizer | 6422-86-2 | 1-5% | 1-5% | Fossil Limited | Non-Renewable |
| Blended Dibenzoates | Plasticizer | 120-55-8<br>19224-26-1<br>21738-31-4 | 1-5% | 1-5% | Fossil Limited | Non-Renewable |
| Recycled Material | Binder | N/A | 5% | 5% | Fossil Limited | Non-Renewable |
| Acrylate | Coating | 52408-84-1 | 0.0% | 0.01-0.1% | Fossil Limited | Non-Renewable |
| Pigments | Titanium Dioxide | 13463-67-7 | 0.5-1% | 0.1-.5% | Abundant Mineral | Non-Renewable |
| | Colored Pigment | Various | 0.01-0.1% | 0.01-0.1% | | |

## 2.8 Manufacturing

Vinyl Composition Tile is floor tile primarily used in commercial flooring applications and is comprised mostly of limestone in a vinyl binder matrix. The manufacturing process involves the hot mixing of the raw materials milled and calendered into a hot sheet that is then cooled before punching into floor tiles. VCT will have a factory applied finish to protect the tile face during packaging and installation.

### Figure 2: Process for Vinyl Composition Tile




## 2.9 Packaging

Armstrong VCT is packaged in a recyclable corrugated box and placed on a wooden pallet for shipping.

## 2.10 Installation

Armstrong Flooring VCT 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 Armstrong Flooring VCT 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 Armstrong Flooring VCT, 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

Armstrong Flooring VCT 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/VCT for additional information regarding Armstrong Flooring VCT.

## 3.1 Functional Unit

The functional unit for this EPD is 1 $m^2$ of 2.0 mm Armstrong Flooring VCT for use over 1 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 1 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 5:

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 includes 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 B1 AND B3-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 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 VCT 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® Installation Guide and required as part of the warranty. For VCT, the recommended maintenance is representative of medium intensity maintenance, as shown in Table 6, however for VCT with Diamond 10®, the recommended maintenance is low intensity. Because maintenance procedures often vary depending on the building owner's maintenance practices, level of use, and traffic conditions, Table 5 provides low, medium and high maintenance scenarios.

### Table 6: Estimated Maintenance Intensity & Assumptions

| MAINTENANCE SCHEDULE | NUMBER OF TIMES PERFORMED IN 1 YEAR (365 DAYS) | | | | ADDITIONAL RESOURCE CONSUMPTION |
|---|---|---|---|---|---|
| | VCT with Diamond 10® Technology | LOW | MEDIUM | HIGH | |
| Sweep /Dry Mop | 260 | 260 | 260 | 260 | None |
| Damp Mop | 26 | 26 | 52 | 104 | Water, pre-diluted cleaner |
| Scrubbing /Spray Buff | 3 | 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. No data set was over 10 years old. 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 VCT to VCT 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 | $kg/m^2$ |
| 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) | 1560 (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 Desposition | 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 VCT products 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 in module B2. Additional, impacts for a 1-year service life including disposal are shown in the tables below.

## Table 13: Impact Assessment Results for 1 m² of VCT

| VCT | 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 | 3.52 | 0.00 | 0.01 | 0.00 | 0.16 | 7.58 |
| Transport | A4 | 0.71 | 0.00 | 0.00 | 0.00 | 0.08 | 1.35 |
| Install | A5 | 0.43 | 0.00 | 0.00 | 0.00 | 0.02 | 2.03 |
| Maintain | B2 | 0.31 | 0.00 | 0.00 | 0.00 | 0.01 | 0.78 |
| Replace | B4 | 9.905 | 5.64E-09 | 3.72E-02 | 2.18E-03 | 0.570 | 23.078 |
| Transport | C2 | 0.148 | 0.000 | 0.001 | 0.000 | 0.016 | 0.278 |
| Disposal | C4 | 0.293 | 0.000 | 0.001 | 0.000 | 0.026 | 0.577 |
| Recycling | D | 0 | 0 | 0 | 0 | 0 | 0 |
| | 75 YEARS | 25.478 | 8.64E-09 | 0.104 | 0.012 | 1.74 | 93.47 |
| | 1 YEAR | 5.41 | 2.82E-09 | 0.020 | 1.27E-03 | 0.31 | 12.60 |

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

| VCT 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 | 3.53 | 1.22E-10 | 9.30E-03 | 6.57E-04 | 0.158 | 7.63 |
| Transport | A4 | 0.71 | -3.84E-15 | 3.42E-03 | 2.83E-04 | 0.078 | 1.35 |
| Install | A5 | 0.39 | 2.71E-09 | 4.50E-03 | 7.72E-05 | 0.021 | 1.88 |
| Maintain | B2 | 0.14 | -7.47E-15 | 2.89E-04 | 5.68E-05 | 5.10E-03 | 0.32 |
| Replace | B4 | 10.136 | 0.000 | 0.038 | 0.002 | 0.600 | 23.436 |
| Transport | C2 | 0.148 | -7.93E-16 | 7.10E-04 | 5.87E-04 | 0.016 | 0.279 |
| Disposal | C4 | 0.293 | -1.51E-14 | 1.32E-03 | 6.74E-05 | 0.027 | 0.577 |
| Recycling | D | 0 | 0 | 0 | 0 | 0 | 0 |
| | 75 YEARS | 25.478 | 8.50E-09 | 0.079 | 0.008 | 1.282 | 58.854 |
| | 1 YEAR | 5.20 | 2.83E-09 | 0.020 | 1.20E-03 | 0.30 | 12.03 |

## 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 VCT

| VCT | 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 | 7.59 | 7.59 | 76.77 | 76.77 | 0.02 |
| Transport | A4 | 0.31 | 0.31 | 10.90 | 10.90 | 0.00 |
| Install | A5 | 0.11 | 0.11 | 16.10 | 16.10 | 0.00 |
| Maintain | B2 | 0.32 | 0.32 | 7.12 | 7.12 | 0.00 |
| Replace | B4 | 17.48 | 17.48 | 236.22 | 236.22 | 0.03 |
| Transport | C2 | 0.06 | 0.06 | 2.25 | 2.25 | 0.00 |
| Disposal | C4 | 0.35 | 0.35 | 4.97 | 4.97 | 0.00 |
| Recycling | D | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | 75 YEARS | 8.74 | 8.74 | 118.11 | 118.11 | 0.02 |
| | 1 YEAR | 49.75 | 49.75 | 881.21 | 881.21 | -0.23 |

### Table 16: Resources Use for 1 m² of VCT with Diamond 10® Technology Coating

| VCT 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 | 7.60 | 7.60 | 77.17 | 77.17 | 0.02 |
| Transport | A4 | 0.31 | 0.31 | 10.90 | 10.90 | 0.00 |
| Install | A5 | 0.08 | 0.08 | 14.90 | 14.90 | 0.00 |
| Maintain | B2 | 0.19 | 0.19 | 3.13 | 3.13 | 0.00 |
| Replace | B4 | 17.20 | 17.20 | 226.64 | 226.64 | 0.04 |
| Transport | C2 | 0.06 | 0.06 | 2.25 | 2.25 | 0.00 |
| Disposal | C4 | 0.35 | 0.35 | 4.97 | 4.97 | 0.00 |
| Recycling | D | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| | 75 YEARS | 8.60 | 8.60 | 113.32 | 113.32 | 0.02 |
| | 1 YEAR | 40.15 | 40.15 | 571.58 | 571.58 | -0.08 |

## Table 17: Outflows and Waste Categories for 1 m² of VCT

| VCT | 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 | 1.35E-04 | 3.67E-01 | -3.31E-06 | -2.69E-03 | 0 | 0 |
| Transport | A4 | 8.20E-08 | 3.81E-04 | -2.70E-08 | -2.19E-05 | 0 | 0 |
| Install | A5 | 7.27E-09 | 4.27E-01 | -4.22E-08 | -3.43E-05 | 1.08E-04 | 5.07E-05 |
| Maintain | B2 | 5.85E-09 | 1.03E-02 | -2.03E-07 | -1.66E-04 | 0 | 0 |
| Replace | B4 | 2.70E-03 | 1.47E+01 | -7.28E-06 | -5.92E-03 | 2.16E-04 | 1.01E-04 |
| Transport | C2 | 1.69E-08 | 7.88E-05 | -5.59E-09 | -4.53E-06 | 0 | 0 |
| Disposal | C4 | 1.61E-08 | 6.75E+00 | -5.59E-08 | -4.36E-05 | 0 | 0 |
| Recycling | D | 0 | 0 | 0 | 0 | 0 | 0 |
| | 75 YEARS | 1.35E-04 | 7.37E+00 | -3.64E-06 | -2.69E-03 | 1.08E-04 | 5.07E-05 |
| | 1 YEAR | 4.05E-04 | 2.29E+01 | -2.60E-05 | -2.11E-02 | 3.42E-04 | 1.52E-04 |

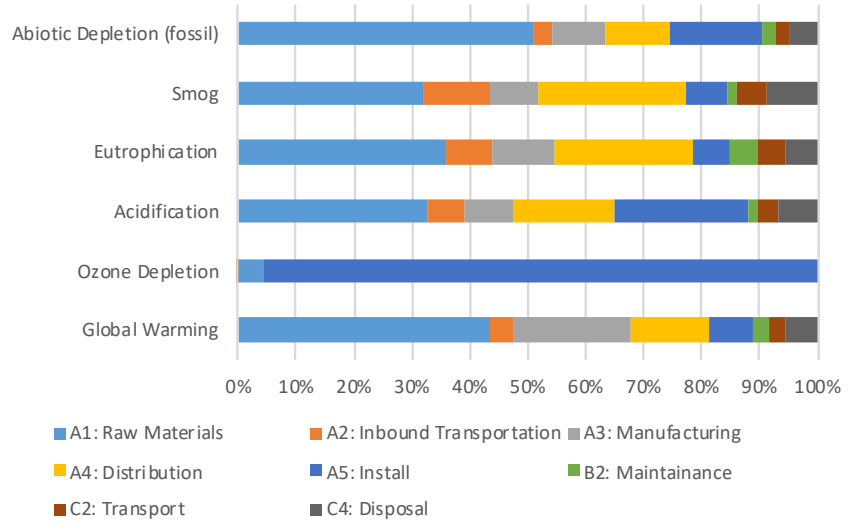
## Table 18: Outflows and Waste Categories for 1 m² of VCT with Diamond 10® Technology Coating

| VCT 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 | 1.42E-04 | 3.67E-01 | -3.31E-06 | -3.65E-05 | 0 | 0 |
| Transport | A4 | 8.21E-08 | 3.82E-04 | -2.71E-08 | -2.46E-07 | 0 | 0 |
| Install | A5 | 6.42E-09 | 4.27E-01 | -2.35E-08 | -2.13E-07 | 1.08E-04 | 5.08E-05 |
| Maintain | B2 | 2.49E-09 | 3.41E-03 | -1.28E-07 | -1.19E-06 | 0 | 0 |
| Replace | B4 | 2.85E-04 | 1.47E+01 | -7.11E-06 | -6.54E-05 | 2.16E-04 | 1.02E-04 |
| Transport | C2 | 1.70E-08 | 7.89E-05 | -5.59E-09 | -5.08E-08 | 0 | 0 |
| Disposal | C4 | 1.61E-08 | 6.57E+00 | -5.59E-08 | -4.45E-07 | 0 | 0 |
| Recycling | D | 0 | 0 | 0 | 0 | 0 | 0 |
| | 75 YEARS | 1.42E-04 | 7.37E+00 | -3.55E-06 | -3.27E-05 | 1.08E-04 | 5.08E-05 |
| | 1 YEAR | 4.28E-04 | 2.24E+01 | -2.024E-05 | -1.86E-04 | 3.24E-04 | 1.52E-04 |

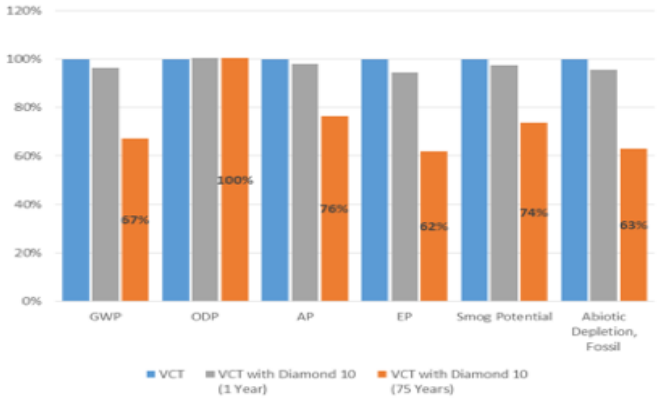
## 5.0 LCA Interpretation

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, installation and disposal of replacement products 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 4. One-Year Life Cycle Impacts for VCT with 10® Technology Coating.




Add following Figure: When VCT is compared with VCT with Diamond 10®, an impact reduction is shown in Figure 4. The impact reduction is the first year is small, 2-4% depending on impact categories, but these impacts when compounded over the life of the building results in impacts reductions from 24-38%.




## 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 a assessment – Requirements and guidelines.

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

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

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

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

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

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