

Integra® HP  
broadloom carpet



**Certified  
Environmental  
Product Declaration**  
[www.nsf.org](http://www.nsf.org)

Mannington is a fourth generation, family-owned company with manufacturing facilities in eight communities across America. Known for creating high performance products for nearly 100 years, the past decade has seen our company rise to a leadership position in the styling and development of long-lasting, low-maintenance flooring systems that incorporate reclaimed waste streams. We divert waste from America’s landfills, incorporating it into our manufacturing, helping make us a net user of waste in our carpet manufacturing – capturing and using more waste than we create. Our energy leadership, including one of the largest solar arrays in the flooring industry helped prompt the US Secretary of Energy to name us an original partner of the Save Energy Now-Better Plants program, setting the standard for reducing energy usage by 2020. From 2007-2014, we also reduced water usage at our carpet operations by nearly 35%. We also hold certifications for ISO-14001, NSF/ ANSI environmentally preferable products, CRI Green Label Plus, and FloorScore. Our products contribute to LEED, Green Globes & other rating systems.


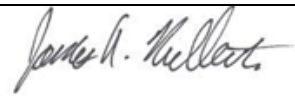
Integra® HP Broadloom, a high performance broadloom backing system, offers industry-leading quality and durability, with exceptional tuft bind and dimensional stability. The backing also incorporates post-consumer recycled content. This backing system is ideal for healthcare, education, retail, and corporate installations.

Mannington Commercial

1844 US Highway 41 S.E.  
Calhoun, GA 30701

1-800-241-2262  
www.mannington.com

**ENVIRONMENTAL PRODUCT DECLARATION VERIFICATION**

EPD Information			
Program Operator	NSF International		
Declaration Holder	Mannington Commercial		
Integra® HP	Date of Issue July 3, 2015	Period of Validity 5 years	Declaration Number EPD10059
This EPD was independently verified by NSF International in accordance with ISO 14025:		 Lori Bestervelt <a href="mailto:Bestervelt@nsf.org">Bestervelt@nsf.org</a>	
<input type="checkbox"/> Internal	<input checked="" type="checkbox"/> External		
This life cycle assessment was independently verified by in accordance with ISO 14044 and the reference PCR:		 Jim Mellentine Sustainable Solutions Corporation <a href="mailto:Jim@SustainableSolutionsCorporation.com">Jim@SustainableSolutionsCorporation.com</a>	
LCA Information			
Basis LCA	Mannington Life Cycle Assessment for Integra® HP Broadloom carpet March 20, 2015		
LCA Preparer	Michael Schiffli Mannington Commercial <a href="mailto:Mike_Schiffli@mannington.com">Mike_Schiffli@mannington.com</a>		
This life cycle assessment was critically reviewed in accordance with ISO 14044 by:	Jim Mellentine Sustainable Solutions Corporation <a href="mailto:Jim@SustainableSolutionsCorporation.com">Jim@SustainableSolutionsCorporation.com</a>		
PCR Information			
Program Operator	NSF International		
Reference PCR	Flooring: Carpet, Resilient, Laminate, Ceramic, Wood Version 2		
Date of Issue	May 21, 2015		
PCR review was conducted by:	Dr. Michael Overcash Environmental Clarity <a href="mailto:movercash@earthlink.net">movercash@earthlink.net</a>		

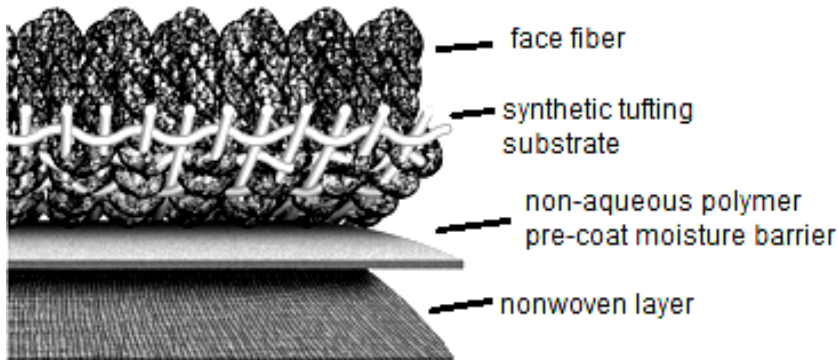
## ENVIRONMENTAL PRODUCT DECLARATION: DETAILED VERSION

 Product DescriptionProduct classification and description

Products covered in this Environmental Product Declaration (EPD) are a broad variety of carpet styles and colors manufactured by Mannington Commercial, backed with our Integra® HP Broadloom backing system and made with either nylon 6,6 or nylon 6 yarn. The fiber in these products (product wear layer) is constructed using nylon 6,6 or nylon 6 yarn that is either solution dyed, space dyed, or a combination of these methods. Integra® HP Broadloom is a vinyl composite backing that is engineered for strong performance, excellent tuft bind, moisture resistance and dimensional stability. Like most Mannington Commercial backing systems, these products are certified as environmentally preferable products to NSF/ANSI 140:2013 Sustainability Assessment for Carpet, to the Gold level and manufactured in the USA in an ISO 14001 registered facility.

The aggregate weight of Integra® HP Broadloom backing system is approximately 53.1 oz/yd<sup>2</sup>. The variation in weight across the Integra® HP Broadloom carpet products is due to the yarn weight. The life cycle assessment for this product group was completed using a yarn weight of 22.7 oz/yd<sup>2</sup> with a sensitivity check being completed using the product group's minimum yarn weight of 14 oz/yd<sup>2</sup> and the maximum yarn weight of 26 oz/yd<sup>2</sup>. Unless otherwise noted, data within this EPD represents an average yarn weight of 22.7 oz/yd<sup>2</sup> and the Integra® HP Broadloom backing system weighing 53.1 oz/yd<sup>2</sup> for a total product weight of 75.8 oz/yd<sup>2</sup>.

Figure 1: Diagram of Integra® HP Broadloom carpet



Definitions

- Face fiber – Fibers of Nylon 6,6 or Nylon 6 yarn that are solution dyed, space dyed or a combination of the two.
- Synthetic tufting substrate – The yarn is tufted into a polyester woven sheet or PET/nylon blended non-woven sheet, also known as primary backing. The polyester woven sheet is composed of 85% post-consumer recycled content.
- Non-aqueous polymer pre-coat moisture barrier – A polymeric material with post-consumer recycled content which bonds the tufts to the primary backing, giving the yarn fibers strength and durability.
- Non-woven layer – A fabric embedded into the backing, which provides dimensional stability.

Applicability

Integra® HP Broadloom carpet is intended for use in high traffic commercial interior spaces and has a reference service life of 15 years. The type of manufacturing (see Table 1) will determine if the flooring is suitable for extra- heavy traffic, as defined in the guidelines developed by the Carpet and Rug Institute (CRI).<sup>1</sup>


<sup>1</sup> [http://www.carpet-rug.org/documents/factsheets/Guidelines\\_for\\_levels\\_of\\_traffic.pdf](http://www.carpet-rug.org/documents/factsheets/Guidelines_for_levels_of_traffic.pdf)

 Product Characteristics

Table 1: Product characteristic table for Integra® HP Broadloom carpet

Type of manufacture	Tufted Textured Loop, Tufted Texture Cut Pile, Tufted Patterned Loop, Tufted Patterned Tip Sheared, Tufted Tip Sheared or Tufted Cut Pile	
Yarn type	Nylon 6,6 or Nylon 6	100%
Secondary backing	Polymeric vinyl compound	100%
<b>Characteristics</b>	<b>Nominal Value</b>	<b>Unit</b>
Number of tufts or loops	981 – 2,710 (9,115 – 25,178)	per dm <sup>2</sup> (per ft <sup>2</sup> )
Yarn weight	475 – 882 (14 - 26)	g/m <sup>2</sup> (oz/yd <sup>2</sup> )
Backing weight	1,800 (53.1)	g/m <sup>2</sup> (oz/yd <sup>2</sup> )
Total product weight	2,275 – 2,682 (67.1 – 79.1)	g/m <sup>2</sup> (oz/yd <sup>2</sup> )
Pile thickness	2.134 – 6.858 (0.084 – 0.270)	mm (inch)
Backing thickness	2.36 (0.093)	mm (inch)
Total thickness	4.494 – 9.218 (0.284 – 0.470)	mm (inch)
Total recycled content	6 – 11	%
<b>Product Standard / Approval</b>		<b>Results</b>
AATCC 134-2011 Electrostatic Propensity		≤3.0 kV
AATCC 16-2004 Colorfastness to Light		≥4 at 40 AFUs
ASTM E648 – Radiant Panel Test		CLASS 1
ASTM E662 – NBS Smoke Test (Flaming Mode)		≤ 450
ASTM D2859 – Methenamine Pill Test		PASSES
ASTM D3936 – Delamination Strength		≥ 3 lbs / in
ASTM D5252, ASTM D7330, CRI TM-101 – Test for Surface Appearance Change (CRI-TARR rating)		≥ 3
Moisture Impact Test		PASSES
British Spill Test		PASSES
The laboratories used for testing have NVLAP Accreditation (NIST) <sup>2</sup> .		
<b>Accreditation</b>		
Carpet and Rug Institute Green Label Plus – Category 17X (CRI indoor air quality control green label plus ID: GLP7616)		
EN14041:2004/A1:2006 CE-Labeling (1121-CPR-DA0029)		
NSF/ANSI 140:2013 Sustainability Assessment for Carpet: Gold		

<sup>2</sup> <http://www.nist.gov/nvlap/>

 Material Content

Material Content of the product

Table 2: Material content table for Integra® HP Broadloom carpet

Component	Material	Mass %	Availability (nature of resource, renewable / recycled, availability)	Origin
Nylon face fiber	Nylon 6,6 (products: 95%)	21 - 33 %	Fossil resource, non renewable, limited	Global
	Nylon 6 (products: 5%)		Fossil resource, non renewable, limited	Global
Synthetic tufting substrate	Polyester (products: 60%)	5 – 6 %	Fossil resource, non renewable, limited (15%) Post-consumer recycled, abundant (85%)	Global
	PET / Nylon (products: 40%)		Fossil resource, non renewable, limited	Global
Non-aqueous polymer pre-coat	Polyvinyl chloride polymer	61 – 72 %	Fossil resource, non renewable, limited	Global
	DOTP		Fossil resource, non renewable, limited	Global
	BBCH		Fossil resource, non renewable, limited	Global
	Calcium carbonate		Mineral, non renewable, abundant	Global
	Glass filler		Post-consumer recycled material, abundant	US
Non-woven layer	Polypropylene	1 – 2 %	Fossil resource, non renewable, abundant	Global
Modifiers	Various	1 – 2%		Global

Production of main materials

*Nylon 6,6*, CAS# 32131-17-2, is synthesized by polycondensation of hexamethylene diamine and adipic acid. (Nylon 6-6, 2007)

*Nylon 6*, CAS# 25038-54-4, is synthesized by ring opening polymerization of caprolactam. Caprolactam is comprised of 6 carbons creating the 6 in Nylon 6. (Nylon 6, 2005)

*Polyester (PET)*, CAS# 25038-59-9, is a synthetic polymer made of purified terephthalic acid (PTA). (Polyester, 2002)

*Polyvinyl chloride (PVC)*, CAS# 9002-86-2, is prepared by polymerization of vinyl chloride monomer. Vinyl chloride monomer is produced from salt and ethylene.

*Calcium carbonate*, CAS# 1317-65-3, is an abundant mineral found worldwide and is the chief substance found in rocks (i.e., marble and limestone). It can be ground into varying particle sizes and is widely used as filler material in formulated flooring systems.

*Dioctyl terephthalate (DOTP)*, CAS# 6422-86-22, is prepared by the reaction of dimethyl terephthalate and 2-ethylhexanol.

*1,2-cyclohexanedicarboxylic acid, 1-butyl 2-(phenylmethyl) ester (BBCH)*, CAS# 1200806-67-2, is synthesized from reacting the salt of mono-butyl dicarboxylic acid and benzyl chloride.

*Glass filler (Glass Cullet)*, CAS# 065997-17-3, is post-consumer recycled glass. It can be ground into varying particle sizes.

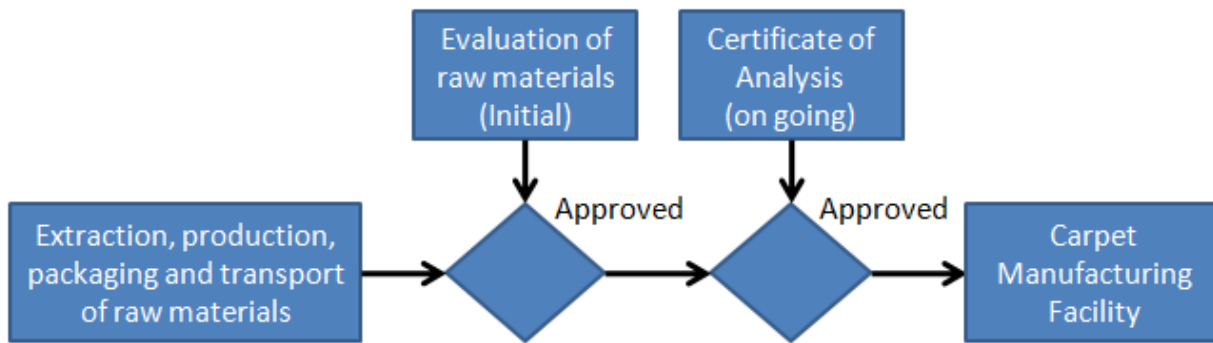
*Polypropylene*, CAS# 9003-07-0, is a thermoplastic polymer created by addition polymerization with the monomer propylene.



### Life Cycle Assessment Stages and Reported EPD Information

#### Sourcing/extraction (raw material acquisition) stage

Figure 2: Diagram of the raw material sourcing and extraction stage



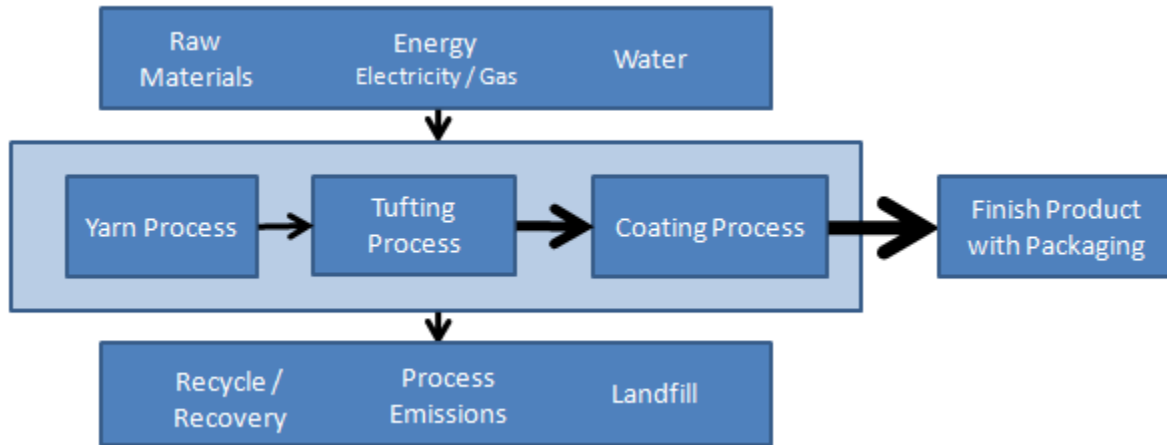
The life cycle assessment stage for sourcing and extraction begins at the point of the raw material being extracted and ends at the point when the packaged raw material is received by the carpet manufacturing facility.

Before a raw material is used, it must first be evaluated for quality, availability, consistency, performance and value before the material will be considered acceptable. Once the material has passed the initial evaluation process; future shipments are evaluated using the suppliers' certificate of analysis.



Manufacturing stage

Figure 3: Diagram of the manufacturing stage



The manufacturing stage begins with the yarn process. The yarn is processed by converting the raw yarns (singles) into a finished yarn that is sent to the tufting process. The processing of raw yarn usually requires electricity, gas and water.

The tufting process involves using a tufting machine utilizing needles to insert the finished yarn into a synthetic tufting substrate (primary backing) to produce various aesthetically pleasing products which are generically referred to as greige carpet. The tufting process requires electricity.

The coating process is the final manufacturing step. The coating process applies a non-aqueous polymer pre-coat moisture barrier, bonds the finished yarn into the primary backing, and the nonwoven layer to complete the product. The product is rolled, packaged and made ready for shipment at the end of the coating process. The coating process requires electricity, gas and water.

*Health, safety, and environmental aspects during production*

- ISO 14001:2004 Environmental Management System
- Better Plants Partner in the U.S. Department of Energy’s Better Plants Program
- NSF/ANSI 140:2013 Sustainability Assessment for Carpet – Section Public health and environment
- Aggressive water conservation program began in 2007 which, as of 2014, has yielded nearly a 35% reduction in site water usage.

*Production waste*

- All packaging materials (cardboard, stretch wrap, shrink wrap and pallets) are recycled / repurposed.
- All scraps and trimmings of yarn, primary backing and backing material are recycled / repurposed.
- Any finish waste is recycled / repurposed.

## Delivery and installation stage

### *Delivery*

Integra® HP Broadloom carpet and sundries are typically transported to the installation site using a diesel powered semi truck. Truck transportation plays a significant role in the distribution of the product.

This life cycle assessment has modeled the delivery using an average distance of 500 miles (805 km) with the diesel powered semi truck having an 85% utilization of its payload.

### *Installation*

The recommended method for installing Integra® HP Broadloom carpet is to use the full adhesive method with Mannington Commercial INTEGRA 2 adhesive. The instructions for this installation procedure can be found on the Mannington Commercial web site (Mannington/Commercial Flooring/Technical/Carpet Installation).<sup>3</sup>

The life cycle assessment modeled the installation stage with INTEGRA 2 adhesive being applied at a rate of 0.353 kg/m<sup>2</sup> or 0.650 lb/yd<sup>2</sup>.

### *Health, safety, and environmental aspects during installation*

The Mannington Commercial INTEGRA 2 adhesive is CRI Green Label Plus (GLP# 07281) certified.<sup>4</sup> The SDS for INTEGRA 2 can be found on the Mannington Commercial web site (Mannington/Commercial Flooring/Technical/Carpet Adhesives).<sup>5</sup>

### *Waste*

Product packaging wastes can be recycled at local recycling centers.

The life cycle assessment modeled a 2% loss of broadloom carpet during the installation process. This life cycle assessment modeled all of the installation waste as being disposed of in a commercial landfill.

### *Packaging*

The carpet is wrapped on a cardboard core and the roll of carpet is then wrapped with a sheet of polyethylene covering. The ends of the roll are secured with cardboard core inserts. Each roll on average contains 139.6 m<sup>2</sup> (167 yd<sup>2</sup>) of product. The material, category and weight of packaging are identified in Table 3.

<sup>3</sup> <http://www.mannington.com/commercial/assets/pdfs/Literature/IntegraHP%20-%20%20IntegraHPRE%20Inst%20-%20INTEGRA%202.pdf>

<sup>4</sup> <http://www.mannington.com/commercial/assets/pdfs/Literature/INTEGRA-2%20Adhesive%20Spec%202012.pdf>

<sup>5</sup> <http://www.mannington.com/commercial/assets/pdfs/Literature/MSDS%20INTEGRA-2%20HP%20RE.pdf>

Table 3: Packaging Material

Material	Category	Weight
Convolutud tube	cardboard	7.3 kg ( 16.0 lbs)
Core inserts	cardboard	0.2 kg ( 0.4 lbs)
Roll Wrap	plastic	1.0 kg ( 2.1 lbs)
Labeling	paper	3.4 gr ( 0.12 oz)

Use stage

*Use of the floor covering*

The service life for Integra® HP Broadloom carpet will vary depending on the amount of floor traffic, level of maintenance and the desired appearance of the floor covering. The reference service life for Integra® HP Broadloom carpet is 15 years.

Integra® HP Broadloom backing system and carpet is guaranteed by Mannington’s warranted performance.

*Cleaning and maintenance*

The level of cleaning and maintenance varies depending on the amount of floor traffic and the desired appearance of the floor that the end user is seeking. The CRI publication titled *Carpet Maintenance Guidelines for Commercial Applications* offers guidance on how to maintain the carpet at various floor traffic levels.<sup>6</sup> Mannington Commercial’s web site also has guidance on the maintenance of carpet (Mannington/Commercial Flooring/Technical/ Carpet Maintenance).<sup>7</sup>

The cleaning and maintenance for the life cycle assessment was modeled as shown in table 4.

Table 4: Cleaning and Maintenance

Level of use	Cleaning process	Cleaning frequency	Consumption of energy and resources
Commercial (light to moderate)	Vacuum	2 x week or 100 x year	Electricity
Commercial (heavy)	Vacuum	5 x week or 250 x year	Electricity
Commercial (light to heavy)	Hot water extraction	2 x year	Electricity, water, cleaning chemicals

<sup>6</sup> [http://www.carpet-rug.org/documents/publications/078\\_Carpet\\_Maintenance\\_Guidelines.pdf](http://www.carpet-rug.org/documents/publications/078_Carpet_Maintenance_Guidelines.pdf)

<sup>7</sup> [http://www.mannington.com/commercial/assets/pdfs/Literature/CarpetCleaning\\_Brochure\\_08.pdf](http://www.mannington.com/commercial/assets/pdfs/Literature/CarpetCleaning_Brochure_08.pdf)

*Structural damage*

The subfloor requirements and instructions for floor preparation can be found on the Mannington Commercial web site (Mannington/Commercial Flooring/Technical/Carpet Installation).<sup>8</sup>

End of life stage

*Recycling, reuse, or repurpose*

Recycling, reuse and repurpose of carpet is the preferred method of disposal for used carpet. According to the Carpet America Recovery Effort<sup>SM</sup> (CARE) latest annual report, over 534 million pounds of carpet was diverted from U.S. landfills in 2013.<sup>9</sup> The CARE website provides information on recycling, reuse and repurposing opportunities across the U.S. Mannington Commercial is an original and long-standing member of CARE.

*Disposal*

Another method of disposal for used carpet is through a local municipal landfill or commercial incinerator facility.

The life cycle assessment modeled the end of life stage with 9% of carpet being recycled, reused, repurposed or incinerated while the remainder was disposed of in a commercial landfill. The benefit of waste to energy from the incineration of used carpet was not factored into this model. The transport of the used carpet to a commercial landfill was modeled using an average distance of 75 miles (121 km) with a diesel power semi truck.

---

<sup>8</sup> <http://www.mannington.com/commercial/assets/pdfs/Literature/IntegraHP%20-%20%20IntegraHPRE%20Inst%20-%20INTEGRA%202.pdf>

<sup>9</sup> <http://www.carpetrecovery.org/>



## Life Cycle Assessment (LCA)

### General

A cradle to grave life cycle assessment (LCA) was completed on this product group in accordance with ISO 14040 (ISO, 2006), ISO 14044 (ISO, 2006) and *Product Category Rule for Environmental Product Declarations Flooring: Carpet, Resilient, Laminate, Ceramic, Wood version 2*. (NSF International, 2014)

The life cycle stages for this study were:

- Sourcing/extraction stage
- Manufacturing stage
- Delivery and installation stage
- Use stage
- End of life stage

All life cycles stages as described in System Boundaries, section 6.9 of the Product Category Rule (PCR) have been included. (NSF International, 2014)

### Description of the functional unit

The functional unit has been defined as one square meter (m<sup>2</sup>). (NSF International, 2014) The reference service life for this product group is 15 years while the reference service life for a building is 60 years.

### Cut-off criteria

The Mass / energy flows and environmental impacts consisting of less than 1% may be omitted from the inventory analysis. Cumulative omitted mass / energy flows or environmental impacts shall not exceed 5%. This does not apply to background data. Variations of these rules shall be documented and justification provided.

To avoid complicating the analysis, this study did not omit any mass / energy flows or environmental impacts from the life cycle inventories.

### Allocation

The allocation procedure used in this study focused on either mass or square yards of output. For example: gallons of process water metered, pounds of greige waste, or finished carpet generated would be allocated proportionately to the square yards of carpet produced by the production line.

The principle of modularity was maintained throughout the study by modeling the material and energy flows to/from the environment at each material, or process element, where they occurred.

An open-loop allocation procedure was used for the packaging of raw materials. An example would be the stretch wrap used to unitize the bags of raw material on a pallet. The stretch wrap life cycle inventory includes transport to the recycle vendor. However, none of the life cycle inventories required to prepare the recycled material for its new life are included nor any credits are taken for the recycled material.

Open-loop allocation procedure was used for the recycled raw materials. An example would be the glass filler. The life cycle inventory includes the transportation from the recycle center to the vendor, energies to transform, wastes, packaging and transport to the Calhoun, GA carpet manufacturing facility. However, none of the life cycle inventories of the materials former life were included.

Background data

As a general rule, specific data derived from specific production processes and/or average data derived from specific production processes was the first choice for the basis of creating this EPD.

SimaPro 8.0.4, developed by PRé Consultants, was used to create the model used for this life cycle assessment.<sup>10</sup> SimaPro 8.0.4 software database was used in most of the background datasets required for this model.<sup>11</sup> The database was used for energy, transportation and auxiliary materials to ensure comparability of the results in the life cycle assessment, see table 5.

Table 5: Background data sources

Material	Data Source	Date
Nylon 6,6	US-EI Database version 2.2	2010 - 2013
Nylon 6	Life Cycle Inventory by Vendor	January 2012
Polyester	US-EI Database version 2.2	2010 - 2013
Calcium Carbonate	US-EI Database version 2.2	2003 - 2013
Polyvinyl chloride	US-EI Database version 2.2	2010 - 2013
Diocyl terephthalate (DOTP)	Life Cycle Inventory by Vendor	November 2011
BBCH	US-EI Database version 2.2	2007 - 2013
Glass Filler	US-EI Database version 2.2	2003 - 2013
Polypropylene	US-EI Database version 2.2	2010 - 2013
Modifiers	US-EI Database version 2.2	2003 - 2013

<sup>10</sup> <http://www.pre-sustainability.com/>

<sup>11</sup> <http://www.earthshift.com/software/simapro/databases>

Data quality

The data used in the life cycle assessment represents current products and processes. This data is considered to be good to very good which meets the requirements of the product category rules. (NSF International, 2014) A variety of checks were built into the model. Additionally, a series of tests were conducted on the model to ensure that the model quality is very good.

Time related coverage – The process data (foreground data) was based on one year of data, 2014. The background data sources are based on data less than 10 years old. All of the background data sources are modeled using 2010 or newer North American energies. The time related coverage is good.

Geographical coverage – The process data was based on North America. The background data sources were first selected based on technological appropriateness and then geographical appropriateness was considered. An example of this is calcium carbonate. Calcium carbonate was modeled on a technological equivalent process while the geographical location of the process was Europe and the energies were modeled for North America. The geographical coverage is good.

Technology coverage – Process data was collected from the actual processes and thus the technology coverage is very good. The background data was selected for technology relevance to ensure the best fit of the life cycle inventory to the real world. The technology coverage is very good.

Table 6: Process data quality (foreground data)

Process	Type of data	Period	Origin of data	Data source	Completeness	Accuracy
Yarn Process	input-output analysis	2014	North America	Manufacturing Plant	Very Good	Very Good
Tufting Process	input-output analysis	2014	North America	Manufacturing Plant	Very Good	Very Good
Coating Process	input-output analysis	2014	North America	Manufacturing Plant	Very Good	Very Good

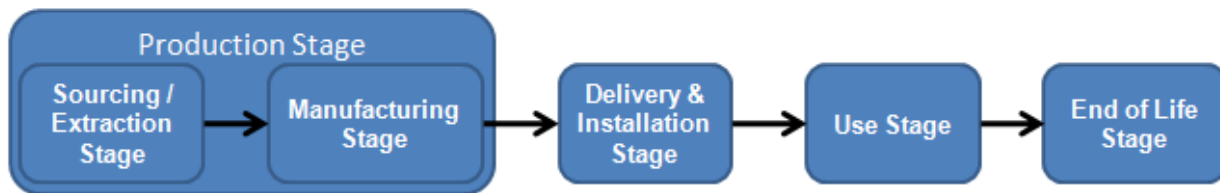
System boundaries

The life cycle assessment for Integra® HP Broadloom backing system was a cradle to grave study. The system boundaries for this study are as follows:

- Sourcing / extraction stage – This stage begins with the design of product concepts, selection and sourcing or materials, evaluation of optimum alternatives, and the results of design decisions through the extraction of materials. This includes extraction of virgin materials from the earth (pre-consumer supply chain). This may include the growth or extraction of all raw materials, and their delivery to the production site. Packaging materials are included.

- Manufacturing stage – This includes all relevant manufacturing processes once the optimum materials to manufacture a product have been selected. Packaging is included. Production of capital goods, infrastructure, production of manufacturing equipment, and personnel-related activities are not included. Heating, artificial lighting, and transport within the production site are excluded, unless they are directly used for the production process.
- Delivery and installation stage – This stage includes the delivery of the floor covering to the point of installation, fitting, and the raw material extraction, and manufacturing of all sundry material for the fitting, if relevant.
- Use stage – The use stage includes the cleaning and maintenance of the floor covering during its life time as well as extraction, manufacturing and transport of all sundry material, it relevant (e.g. cleaning materials, floor finishes) for the maintenance.
- End of life stage – The end of life stage includes the transport of the floor covering to end of life processes such as incineration, recycling and final disposition. All waste management processes are included in the calculation until final disposition, with the exception of the disposition of nuclear waste, which cannot be modeled due to its extremely long disposition times.

Figure 4: System Boundaries



Note on use stage

“The estimated service of a floor covering and references thereof depend on the type of floor covering, its application, the user, and required maintenance of the product. Comparisons of different floor coverings are allowed only if these parameters are considered in a consistent way and if LCA impacts are evaluated under the same normalized conditions. For this purpose, the use stage impacts shall be reported for a single year (1/60<sup>th</sup> of the total) of use and for the expected life of the building (60 years).” (NSF International, 2014)

Integra® HP Broadloom carpet has a reference service life of 15 years. The recommended maintenance schedule for Integra® HP Broadloom carpet can be reviewed in Table 4.

Results of the Assessment

The CML-IA Baseline Aug 2014 version 3.02 methodology was used to calculate the LCIA values.<sup>12</sup> The following categories from the methodology were selected for the assessment. (NSF International, 2014)

<sup>12</sup> <http://cml.leiden.edu/software/data-cmlia.html>



- Abiotic depletion potential (AD) – kb Sb eq
- Abiotic depletion potential – fossil fuels (AD ff) – MJ
- Global warming potential 100a (GWP) – kg CO2 eq
- Acidification potential (AP) – kg SO2 eq
- Photochemical oxidant formation potential (POCP) – kg C2H2 eq
- Eutrophication potential (NP) – kg PO4 eq
- Ozone depletion potential (ODP) – Steady State / Infinite – kg CFC-11 eq
- Biomass CO2 emissions (Bio) – kg
- Primary energy of non-renewable resources (PE N) – MJ
- Primary energy of renewable resources (PE R) – MJ

Life cycle impact assessment

The CML-IA Baseline Aug 2014 version 3.02 methodology was used to calculate the impact assessments for one square meter of Integra® HP Broadloom carpet product with a face weight of 22.7 oz/yd<sup>2</sup>. Table A displays the impacts for a single installation (Production Stage, Delivery & Installation Stage, End of Life Stage) while table B displays the impacts of the use stage which represents an average one year of use. Table C displays the impacts of the flooring for the entire life of a building (60 year service life) which would require 4 replacements of the carpet product (15 year service life).

Table A: Life cycle stage Impacts for a single installation

Impact Category	Units	Sourcing / Extraction	Manufacture	Delivery & Installation	End of Life	Total
AD	kg Sb eq	2.986E-06	5.977E-08	4.927E-08	3.501E-10	3.100E-06
AD ff	MJ	2.036E+02	3.503E+01	2.425E+01	9.878E-01	2.676E+02
GWP	kg CO2 eq	1.264E+01	2.516E+00	1.179E+00	1.357E+00	1.800E+01
AP	kg SO2 eq	6.496E-02	2.053E-02	7.175E-03	6.030E-04	9.559E-02
POCP	kg C2H4 eq	3.117E-03	8.637E-04	4.053E-04	3.587E-04	4.839E-03
NP	kg PO4--- eq	1.226E-02	2.531E-03	8.826E-04	6.743E-03	2.288E-02
ODP	kg CFC-11 eq	2.154E-07	3.986E-08	1.280E-07	6.050E-09	3.967E-07
Bio	kg	1.365E-01	1.413E-01	3.889E-03	3.665E-01	6.544E-01
PE N	MJ	2.240E+02	4.201E+01	2.512E+01	1.083E+00	2.974E+02
PE R	MJ	6.096E+00	3.255E+00	1.493E-01	1.342E-02	9.706E+00

Figure 5 reviews at the percentage that each stage represents of the total value of each individual impact category in table A.

Figure 5: Life cycle stages as a percentage of each impact category

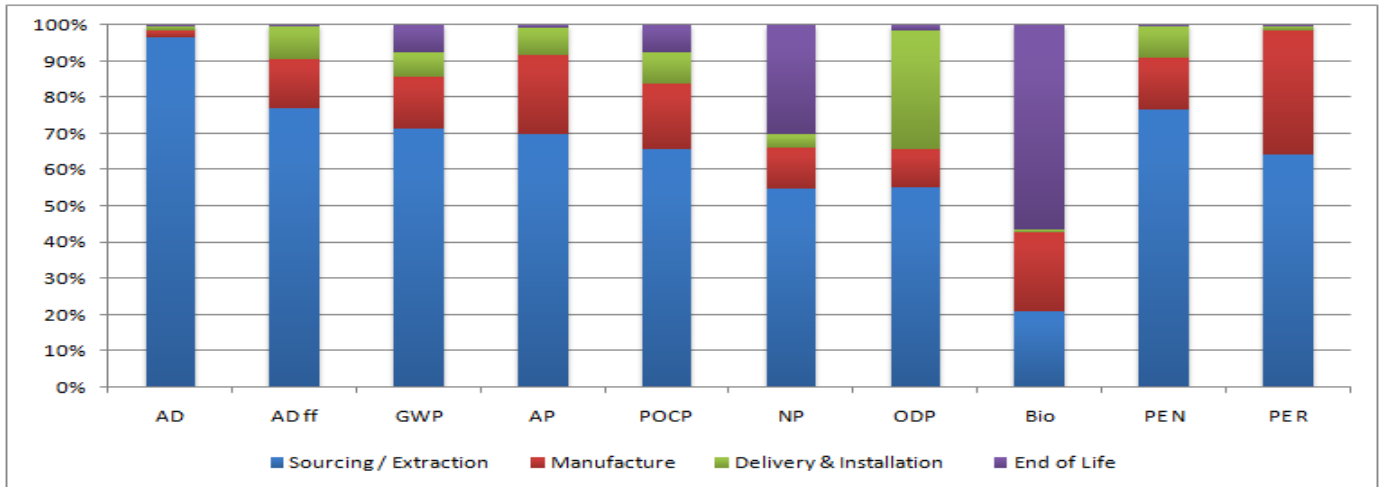


Table B: Use stage impacts (1 Year)

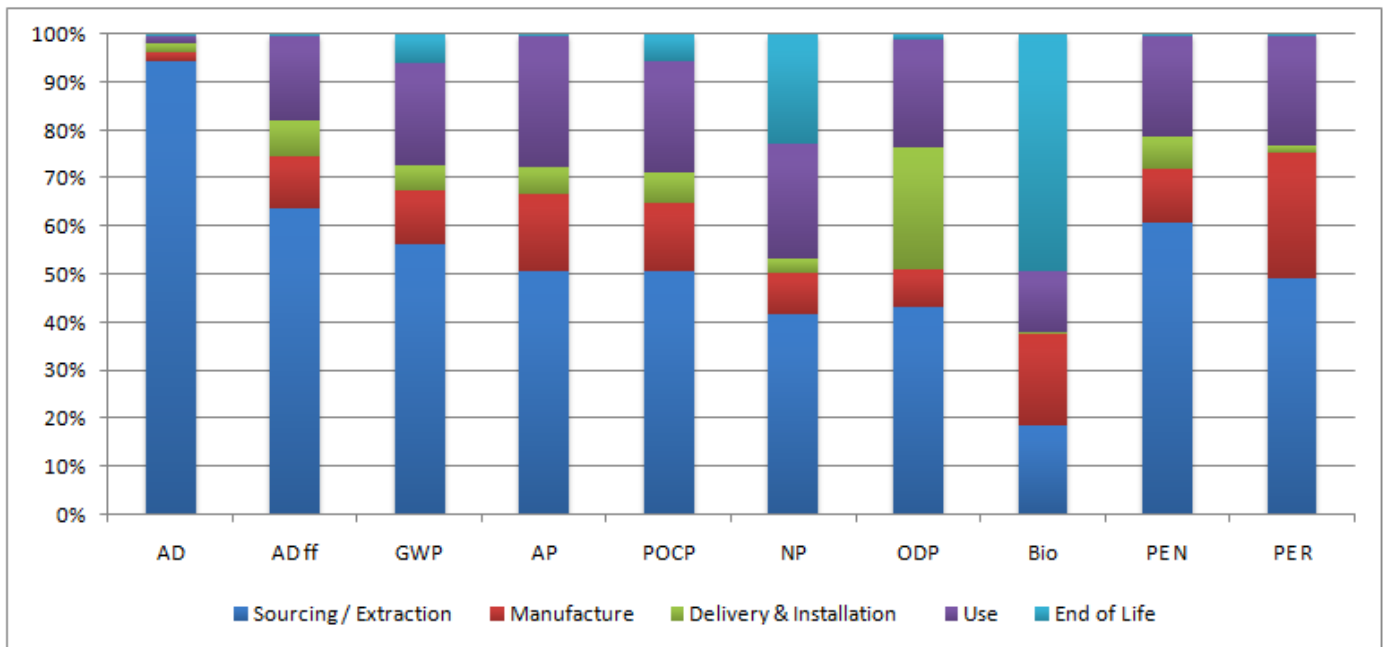
Impact Category	Units	Use Stage
AD	kg Sb eq	4.449E-09
AD ff	MJ	3.757E+00
GWP	kg CO2 eq	3.159E-01
AP	kg SO2 eq	2.326E-03
POCP	kg C2H4 eq	9.403E-05
NP	kg PO4--- eq	4.653E-04
ODP	kg CFC-11 eq	7.425E-09
Bio	kg	6.244E-03
PE N	MJ	5.144E+00
PE R	MJ	1.920E-01

Table C: Life Cycle Stage Impacts for a building life of 60 years

Impact Category	Units	Sourcing / Extraction	Manufacture	Delivery & Installation	Use	End of Life	Total
AD	kg Sb eq	1.194E-05	2.391E-07	1.971E-07	2.669E-07	1.401E-09	1.265E-05
AD ff	MJ	8.144E+02	1.401E+02	9.700E+01	2.254E+02	3.951E+00	1.281E+03
GWP	kg CO2 eq	5.054E+01	1.007E+01	4.718E+00	1.895E+01	5.430E+00	8.971E+01
AP	kg SO2 eq	2.598E-01	8.211E-02	2.870E-02	1.396E-01	2.412E-03	5.126E-01
POCP	kg C2H4 eq	1.247E-02	3.455E-03	1.621E-03	5.642E-03	1.435E-03	2.462E-02
NP	kg PO4--- eq	4.902E-02	1.012E-02	3.531E-03	2.792E-02	2.697E-02	1.176E-01
ODP	kg CFC-11 eq	8.614E-07	1.595E-07	5.120E-07	4.455E-07	2.420E-08	2.003E-06
Bio	kg	5.461E-01	5.651E-01	1.556E-02	3.746E-01	1.466E+00	2.967E+00
PE N	MJ	8.960E+02	1.681E+02	1.005E+02	3.086E+02	4.332E+00	1.478E+03
PE R	MJ	2.439E+01	1.302E+01	5.970E-01	1.152E+01	5.368E-02	4.958E+01

Figure 6 reviews at the percentage that each stage represents of the total value of each individual impact category in table C.

Figure 6: Life cycle stages as a percentage of each impact category



The final table shows the LCIA using CML 2001 Nov 09 methodology for one square meter of Integra® HP Broadloom carpet product with one year of annual use at a variety of face weights, table 7.

Table 7: Life Cycle Stage Impacts for a one year Use Stage with a variety of face weights

Impact Category	Units	14 oz/yd <sup>2</sup> 475 gr/m <sup>2</sup>	16 oz/yd <sup>2</sup> 542 gr/m <sup>2</sup>	18 oz/yd <sup>2</sup> 610 gr/m <sup>2</sup>	20 oz/yd <sup>2</sup> 678 gr/m <sup>2</sup>	22 oz/yd <sup>2</sup> 746 gr/m <sup>2</sup>	24.0 oz/yd <sup>2</sup> 814 gr/m <sup>2</sup>	26 oz/yd <sup>2</sup> 882 gr/m <sup>2</sup>
AD	kg Sb eq	2.199E-06	2.406E-06	2.613E-06	2.820E-06	3.027E-06	3.234E-06	3.441E-06
AD ff	MJ	2.189E+02	2.301E+02	2.413E+02	2.525E+02	2.637E+02	2.749E+02	2.860E+02
GWP	kg CO2 eq	1.455E+01	1.534E+01	1.614E+01	1.693E+01	1.773E+01	1.852E+01	1.931E+01
AP	kg SO2 eq	8.020E-02	8.374E-02	8.727E-02	9.081E-02	9.435E-02	9.788E-02	1.014E-01
POCP	kg C2H4 eq	4.056E-03	4.236E-03	4.416E-03	4.596E-03	4.776E-03	4.956E-03	5.136E-03
NP	kg PO4 <sup>---</sup> eq	1.831E-02	1.936E-02	2.041E-02	2.146E-02	2.251E-02	2.356E-02	2.461E-02
ODP	kg CFC-11 eq	3.542E-07	3.639E-07	3.737E-07	3.835E-07	3.933E-07	4.030E-07	4.128E-07
Bio	kg	5.700E-01	5.894E-01	6.088E-01	6.282E-01	6.476E-01	6.669E-01	6.863E-01
PE N	MJ	2.427E+02	2.552E+02	2.678E+02	2.804E+02	2.929E+02	3.055E+02	3.181E+02
PE R	MJ	8.152E+00	8.509E+00	8.866E+00	9.223E+00	9.580E+00	9.938E+00	1.029E+01

Interpretation

The interpretation of the LCIA results for one square meter of Integra® HP Broadloom carpet yields several observations. After reviewing figures 5 and 6, the largest contributor in most of the studied impact categories is the sourcing / extraction stage.

Over the life of the building, figure 6, the second largest contributor to the impact categories is the use stage. However if the reader reviews table A and B, the reader would see that delivery & installation stage would be rated second highest in most of the impact stages. The noted differences would be due to the time frame referenced. The delivery & installation stage only occurs once every 15 years; whereas, the use stage occurs continuously over the life of the product.

The sensitivity analysis of the model with respect to the face weight demonstrates that even though a change in the face weight from 14 oz/yd<sup>2</sup> to 26 oz/yd<sup>2</sup> is a 9% increase in the total mass of the material, some impact categories increased more than 9%. Take for example, global warming potential (GWP); the value increased by 33%. Examples of other increases greater than the 9% total mass are photochemical oxidation (POCP) and eutrophication potential (NP).



## References

EarthShift. (2000). *SimaPro LCA Software: LCA software for measuring sustainability impact*. Retrieved May 1, 2013, from <http://www.EarthShift.com>: <http://www.earthshift.com/software/simapro>

ISO. (2006). *ISO 14040 Environmental management - Life cycle assessment - Principles and framework* (Second ed.). Geneva: Document Engineer Co., Inc.

ISO. (2006). *ISO 14044 Environmental management - Life cycle assessment - Requirements and guidelines* (First ed.). Geneva: Document Engineering Co., Inc.

NSF International. (2014). *Product Category Rule for Environmental Product Declarations Flooring: Carpet, Resilient, Laminate, Ceramic, Wood version 2*. Ann Arbor, MI: NSF International.

*Nylon 6*. (2005, June 23). Retrieved 24 April, 2013, from Wikipedia, the free encyclopedia: [http://en.wikipedia.org/wiki/Nylon\\_6](http://en.wikipedia.org/wiki/Nylon_6)

*Nylon 6-6*. (2007, June 7). Retrieved April 24, 2013, from Wikipedia, the free encyclopedia: [http://en.wikipedia.org/wiki/Nylon\\_6-6](http://en.wikipedia.org/wiki/Nylon_6-6)

*Polyester*. (2002, October 2). Retrieved April 24, 2013, from Wikipedia, the free encyclopedia: <http://en.wikipedia.org/wiki/Polyester>