

ENVIRONMENTAL PRODUCT DECLARATION

According to ISO 14025 and ISO 21930:2017

NON-REINFORCED EPDM MEMBRANE

SINGLE PLY ROOFING INDUSTRY (SPRI)



About SPRI

SPRI is the recognized technical and statistical authority on the Single Ply Roofing Industry. SPRI provides the best forum for its members to collectively focus their industry expertise and efforts on critical industry issues. By acting as a trade organization, as opposed to each member working individually, the group can effectively improve product quality, installation techniques, workforce training and other issues common to the industry. This approach enables every SPRI member to operate more effectively in the commercial roofing marketplace.

SPRI represents sheet membrane and related component suppliers in the commercial roofing industry.

Since 1981, SPRI has been an excellent resource for building owners, architects, engineers, specifiers, contractors and maintenance personnel, providing objective information about commercial roofing components and systems.

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Declaration Number: ASTM-EPD335

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Non-Reinforced EPDM Single Ply Roofing Membrane

DECLARATION INFORMATION

| Declaration | |
|---|--|
| Program Operator: ASTM International Company: Single Ply Roofing Industry 465 Waverley Oaks Road, Suite 421 Waltham, MA 02452 Tel: (781) 647-7026 Email: info@spri.org |  www.astm.org |
| Product Information | Validity / Applicability |
| Product Name: Non-Reinforced EPDM Single Ply Roofing Membrane Product Definition: Non-Reinforced ethylene propylene diene monomer (EPDM) Single Ply Roofing Membrane Declaration Type: Business-to-business (B2B) PCR Reference: <ul style="list-style-type: none"> Core PCR: ISO 21930:2017 (ISO, 2017) Sub-category PCR: Product Category Rules for Single Ply Roofing Membranes (NSF International, 2019) | Period of Validity: This declaration is valid for a period of 5 years from the date of publication. Geographic Scope: North America PCR Review was conducted by: <ul style="list-style-type: none"> Thomas P. Gloria, Ph.D., Industrial Ecology Consultants Bill Stough, Sustainable Research Group Jack Geibig, EcoForm |
| Product Application and/or Characteristics | |
| Single ply, non-reinforced EPDM membrane representative of 45, 60, and 90 mil thicknesses are used as a roofing protective layer for building applications. | |
| Content of the Declaration | |
| <ul style="list-style-type: none"> Product definition and physical building-related data Details of raw materials and material origin Description of how the product is manufactured Life Cycle Assessment results Additional environmental information | |
| Verification | |
| Independent verification of the declaration and data, according to ISO 21930:2017 and ISO 14025:200 | <input type="checkbox"/> internal <input checked="" type="checkbox"/> external |
| This declaration and the rules on which this EPD is based have been examined by an independent verifier in accordance with ISO 14025. | |
| <i>Limitations</i> <i>The environmental impact results of EPDM products in this document are based on a declared unit and therefore do not provide sufficient information to establish comparisons. The results shall not be used for comparisons without knowledge of how the physical properties of the EPDM product impact the precise function at the construction level. The environmental impact results shall be converted to a functional unit basis before any comparison is attempted. See Section 3.10 For additional EPD comparability guidelines. Environmental declarations from different programs (ISO 14025) may not be comparable.</i> | |



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EPD SUMMARY

This document is a Type III environmental product declaration by Single Ply Roofing Industry (SPRI) that is certified by ASTM International (ASTM) as conforming to the requirements of ISO 21930 and ISO 14025. ASTM has assessed that the Life Cycle Assessment (LCA) information fulfills the requirements of ISO 14040 in accordance with the instructions listed in the referenced product category rules. 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.

No comparisons or benchmarking is included in this EPD. Environmental declarations from different programs based upon differing PCRs may not be comparable. In general, EPDs may not be used for comparability purposes when not considered in a construction works context. Given this PCR ensures products meet the same functional requirements, comparability is permissible provided the information given for such comparison is transparent and the limitations of comparability explained. Only EPDs prepared from cradle-to-grave life-cycle results, and based on the same function, quantified by the same functional unit, and taking account of replacement based on the product reference service life (RSL) relative to an assumed building service life, can be used to assist purchasers and users in making informed comparisons between products. When comparing EPDs created using this PCR, variations and deviations are possible. Example of variations: Different LCA software and background LCI datasets may lead to different results for upstream or downstream of the life cycle stages declared.

SCOPE AND BOUNDARIES OF THE LIFE CYCLE ASSESSMENT

The Life Cycle Assessment (LCA) was performed according to ISO 14040 (ISO, 2020a) and ISO 14044 (ISO, 2020b) following the requirements of the ASTM EPD Program Instructions and the referenced PCR.

System Boundary: Cradle-to-gate

Allocation Method: Mass allocation was selected since the environmental burden in the industrial process (energy consumption, emissions, etc.) is primarily governed by the mass throughput of each sub-process.

Declared Unit: 1 m² of single ply roofing membrane for a stated product thickness. Environmental performance results therefore represent the industry average production of EPDM, normalized to 1 m².



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GENERAL INFORMATION

DESCRIPTION OF COMPANY/ORGANIZATION

The following SPRI members provided data for the product under study:



Carlisle Construction Materials
1285 Ritner Hwy
Carlisle, PA 17013
www.carlisleconstructionmaterials.com



Johns Manville
P. O. Box 5108717
17th Street
Denver, CO 80217-5108
www.jm.com



Firestone Building Products
200 4th Avenue South
Nashville, TN 37201
www.firestonebpc.com

PRODUCT DESCRIPTION

The product system evaluated in this report is a single ply non-reinforced EPDM roofing membrane at the finished nominal thicknesses produced by SPRI members. See Table 1 for membrane specification and standard.

Table 1 Membrane specification and standard

| Roof System | Roof System Component | Declared Thicknesses and Weights | Standard |
|--|-----------------------|---|------------|
| Non-Reinforced ethylene propylene diene monomer (EPDM) | Membrane | 45 mils: 1.38 kg/m ² 60 mils: 1.81 kg/m ² 90 mils: 2.82 kg/m ² | ASTM D4637 |



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Flow Diagram

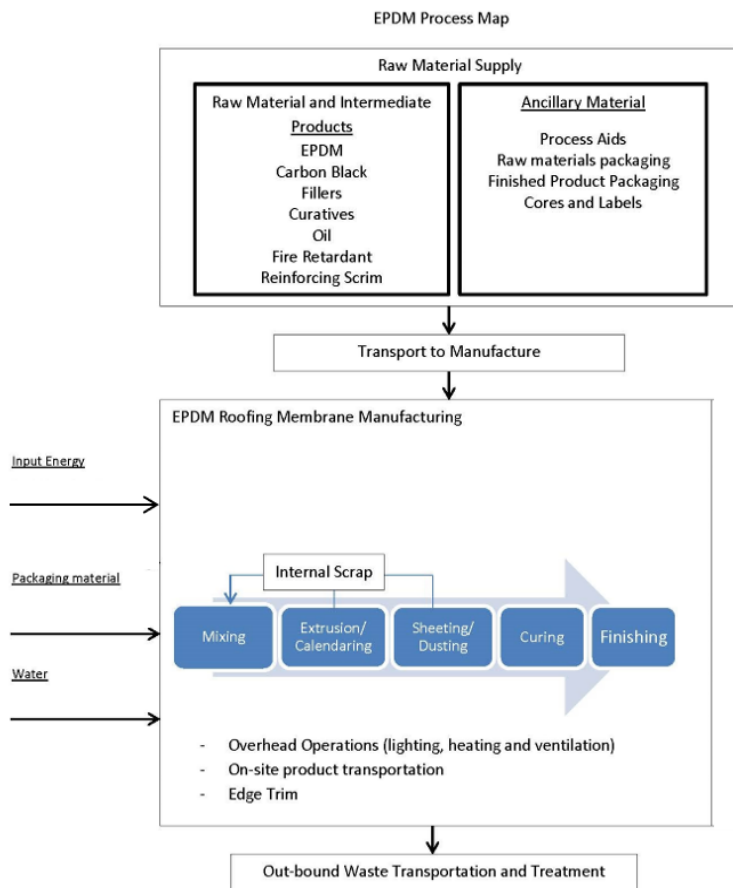


Figure 1. EPDM production process map (courtesy of Johns Manville)

PRODUCT AVERAGE

The 2019 production data used in this EPD considers non-reinforced EPDM roofing membranes produced by the participating members of SPRI in four (4) sites in North America during the year. The participating facilities are:

- Carlisle, PA
- Greenville, IL
- Prescott, AR
- Milan, OH

Results are weighted according to production totals at participating facilities.



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APPLICATION

Non-reinforced EPDM membranes are utilized in commercial roofing systems and provide excellent long term weatherability, hail resistance, and repairability. EPDM membranes are typically used in low slope (roof slope < 2:12) applications, however they can also be used in steep slope applications. The maximum slope roof membrane products can be used at is typically determined by the maximum slope they can achieve and still meet building code required fire classifications.

There are many variables that must be considered when deciding which single ply membrane to select for a particular job. Some examples of variables that should be considered are meeting local building and energy code requirements, roof layout (e.g., are there numerous penetrations?), required design life, cost (initial and over the required design life), and product installation expertise of the roofing contractor.

MATERIAL COMPOSITION

Table 2 shows the input material for non-reinforced EPDM roofing membranes and their material percentages for the three membrane thicknesses.

Table 2 Average composition of non-reinforced EPDM roofing membrane

| Material | % Composition |
|-----------------------|----------------------|
| Base resin (EPDM) | 26.3 |
| Filler | 15.8 |
| Paraffinic oil | 18.9 |
| Pigment | 23.4 |
| EPDM scrap (internal) | 4.7 |
| Fire retardant | 8.3 |
| Activator | <1 |
| Curative | 2.0 |
| Polyester scrim | 0 |
| Processing aid | <1 |

MANUFACTURING

The main material input into the manufacturing process is EPDM rubber in the form of pellets and (uncured) scrap. Additional materials include various additives, which aid in the manufacturing process (e.g., accelerators) and which enhance the membrane's performance (e.g., fire retardants and pigments). The mix is heated, stirred and extruded into a sheet. The sheet is then pressed to achieve the specified thickness, cut and rolled up along with protective plastic sheeting. EPDM scrap



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generated during the aforementioned steps can be directly looped back as a material input, before the subsequent curing (or vulcanizing) process alters the rubber material irreversibly, making it unfit as a scrap input. Curing entails the rolled up membrane being wrapped to create pressure and placed in an oven. Once cured, the membrane sheet maintains its shape and size. Optionally, a reinforcing polyester scrim can be applied to the membrane before curing, producing reinforced EPDM (see SPRI's EPD for EPDM reinforced roofing membranes for details). The finished product is allowed to cool on rollers, then transferred onto large cardboard rolls and wrapped in plastic film to be shipped to building sites for installation.

TRANSPORTATION

Primary data on inbound transportation of raw materials and packaging material were collected. These materials included base resin (EPDM), fillers, pigments, curatives, activators, processing aids, etc. Transportation to the customer or construction site is outside the scope of this EPD.

PRODUCT INSTALLATION

Installation is outside the scope of this EPD.

USE

Product use is outside the scope of this EPD.

REUSE, RECYCLING, AND ENERGY RECOVERY

Product reuse, recycling, and incineration for energy recovery is outside the scope of this EPD.

DISPOSAL

Product disposal is outside the scope of this EPD.



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METHODODOLOGICAL FRAMEWORK

DECLARED UNIT

1 m² of single ply roofing membrane for a stated product thickness. Environmental performance results therefore represent the industry average production of EPDM, normalized to 1 m². The reference service life is not specified. Since the use stage is not included in the system boundary, no reference service life needs to be defined for the analysis.

SYSTEM BOUNDARY

System boundaries are summarized in Figure 2 for the analysis scope of "cradle-to-gate". Excluded modules are indicated by "MND" or "module not declared". As is typical of works of life cycle assessment, the construction and maintenance of capital equipment, such as production equipment in the manufacturing stage, are not included in the system, nor are human labor and employee commute. The use stage is also outside the scope of this study.

| PRODUCT STAGE | | | CONSTRUCTION PROCESS STAGE | | USE STAGE | | | | | | | END OF LIFE STAGE | | | | BENEFITS AND LOADS BEYOND THE SYSTEM BOUNDARY |
|---------------------|-----------|---------------|-----------------------------|------------------|-----------|-------------|--------|-------------|---------------|--|---|-------------------|-----------|------------------|----------|---|
| Raw material supply | Transport | Manufacturing | Transport from gate to site | Assembly/Install | Use | Maintenance | Repair | Replacement | Refurbishment | Building Operational Energy Use During Product Use | Building Operational Water Use During Product Use | Deconstruction | Transport | Waste processing | Disposal | Reuse, Recovery, Recycling Potential |
| A1 | A2 | A3 | A4 | A5 | B1 | B2 | B3 | B4 | B5 | B6 | B7 | C1 | C2 | C3 | C4 | D |
| X | X | X | MND | MND | MND | MND | MND | MND | MND | MND | MND | MND | MND | MND | MND | MND |

Figure 2 Life cycle stages included in system boundary

CUT-OFF RULES

Per the PCR, the cut-off criteria for flows to be considered within each system boundary are as follows:

- Mass: If a flow is less than 1% of the cumulative mass of the model flows, it may be excluded, provided its environmental relevance is minor, based on a sensitivity analysis.
- Energy: If a flow is less than 1% of the cumulative energy of the system model, it may be excluded, provided its environmental relevance is minor, based on a sensitivity analysis.
- Environmental relevance: If a flow meets the above two criteria but is determined to contribute 2% or more to the selected impact categories of the products underlying the EPD, based on a sensitivity analysis, it is included within the system boundary.

At least 95% of the mass flows shall be included and the life-cycle impact data shall contain at least 95% of all elementary flows that contribute to each of the declared category indicators. A list of hazardous and toxic materials and substances



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shall be included in the inventory and the cut-off rules do not apply to such substances.

No cut-off criteria had to be applied for this study. All available energy and material flow data were included in the model.

DATA SOURCES

The LCA model was created using the GaBi Software system for life cycle engineering, version 10, developed by Sphera (Sphera, 2021). Background life cycle inventory data for raw materials and processes were obtained from the GaBi 2021 databases. Primary manufacturing data were provided by the participating companies.

DATA QUALITY

As the majority of the relevant foreground data are measured data or calculated based on primary information sources of the owner of the technology, precision is considered to be high. Seasonal variations were balanced out by using yearly averages that were then weighted according to each manufacturer's production volume. All background data are sourced from GaBi databases with the documented precision. Each foreground process was checked for mass balance and completeness of the emission inventory. No data were knowingly omitted. Completeness of foreground unit process data is considered to be high. All background data are sourced from GaBi databases with the documented completeness.

GEOGRAPHICAL COVERAGE

This study represents three SPRI member companies with facilities across the United States. As such, the geographical coverage for this study is based on US system boundaries for all processes and products.

Regionally specific datasets, where available, were used to represent each manufacturing location's energy consumption. Proxy datasets were used as needed for raw material inputs to address lack of data for a specific material or for a specific geographical region. These proxy datasets were chosen for their technological representativeness of the actual materials.

PERIOD UNDER REVIEW

Primary data collected represent production during the 2019 calendar year. This analysis is intended to represent production in 2019. All secondary data come from the GaBi Professional databases and are representative of the years 2017-2020.

ALLOCATION

As several products are often manufactured at the same plant, participating companies used mass allocation to report data. Mass allocation was selected since the environmental burden in the industrial process (energy consumption, emissions, etc.) is primarily governed by the mass throughput of each sub-process.

Allocation of background data (energy and materials) taken from the GaBi 2021 databases is documented online at <http://www.gabi-software.com/support/gabi/gabi-database-2021-lci-documentation/>.

ESTIMATES AND ASSUMPTIONS

In cases where no matching life cycle inventories were available to represent a flow, proxy data were applied based on



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conservative assumptions regarding environmental impacts.

LIFE CYCLE ASSESSMENT RESULTS

The environmental impacts associated with the non-reinforced roofing membrane is presented below in Table 3 for the production stage (A1-A3).

Table 3: Environmental impact indicators for 1m² of Non-Reinforced EPDM Single Ply Roofing Membrane

| Indicator | A1 | A2 | A3 | Total |
|---|----------|----------|----------|----------|
| Global Warming Potential [kg CO₂ eq.] | | | | |
| EPDM (NR) 45 mils | 3.59E+00 | 1.14E-01 | 1.03E+00 | 4.73E+00 |
| EPDM (NR) 60 mils | 4.69E+00 | 1.47E-01 | 1.30E+00 | 6.14E+00 |
| EPDM (NR) 90 mils | 7.33E+00 | 2.31E-01 | 2.00E+00 | 9.56E+00 |
| Ozone Depletion Potential [kg CFC-11 eq.] | | | | |
| EPDM (NR) 45 mils | 4.19E-15 | 2.22E-17 | 7.99E-13 | 8.02E-13 |
| EPDM (NR) 60 mils | 5.46E-15 | 2.89E-17 | 1.10E-12 | 1.11E-12 |
| EPDM (NR) 90 mils | 8.53E-15 | 4.53E-17 | 1.73E-12 | 1.73E-12 |
| Acidification Potential [kg SO₂ eq.] | | | | |
| EPDM (NR) 45 mils | 5.82E-03 | 1.01E-03 | 9.50E-04 | 7.76E-03 |
| EPDM (NR) 60 mils | 7.59E-03 | 1.23E-03 | 1.24E-03 | 1.00E-02 |
| EPDM (NR) 90 mils | 1.19E-02 | 1.91E-03 | 1.91E-03 | 1.57E-02 |
| Eutrophication Potential [kg N eq.] | | | | |
| EPDM (NR) 45 mils | 5.15E-04 | 6.33E-05 | 9.32E-05 | 6.71E-04 |
| EPDM (NR) 60 mils | 6.81E-04 | 8.03E-05 | 1.22E-04 | 8.83E-04 |
| EPDM (NR) 90 mils | 1.07E-03 | 1.26E-04 | 1.89E-04 | 1.38E-03 |
| Photochemical ozone formation, human health [kg O₃ eq.] | | | | |
| EPDM (NR) 45 mils | 1.03E-01 | 2.29E-02 | 1.74E-02 | 1.43E-01 |
| EPDM (NR) 60 mils | 1.35E-01 | 2.83E-02 | 2.27E-02 | 1.86E-01 |
| EPDM (NR) 90 mils | 2.11E-01 | 4.42E-02 | 3.50E-02 | 2.90E-01 |

The resource use associated with the non-reinforced roofing membrane is presented below in Table 4 for the production stage (A1-A3).

Table 4: Resource use indicators for 1m² of Non-Reinforced EPDM Single Ply Roofing Membrane

| Indicator | A1 | A2 | A3 | Total |
|--|----------|----------|----------|----------|
| Renewable Primary Energy Resources as Energy (RPR_E) [MJ] | | | | |
| EPDM (NR) 45 mils | 1.94E+00 | 5.97E-02 | 5.15E-01 | 2.52E+00 |
| EPDM (NR) 60 mils | 2.55E+00 | 7.89E-02 | 5.49E-01 | 3.18E+00 |
| EPDM (NR) 90 mils | 4.00E+00 | 1.24E-01 | 8.78E-01 | 5.01E+00 |
| Renewable Primary Resources as Material (RPR_M) [MJ] | | | | |
| EPDM (NR) 45 mils | 0.00E+00 | 0.00E+00 | 1.86E+00 | 1.86E+00 |
| EPDM (NR) 60 mils | 0.00E+00 | 0.00E+00 | 2.59E+00 | 2.59E+00 |



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| | | | | |
|---|----------|----------|----------|----------|
| EPDM (NR) 90 mils | 0.00E+00 | 0.00E+00 | 4.00E+00 | 4.00E+00 |
| Non-Renewable Primary Resources as Energy (fuel) (NRPR_E) [MJ] | | | | |
| EPDM (NR) 45 mils | 3.92E+01 | 1.64E+00 | 1.30E+01 | 5.38E+01 |
| EPDM (NR) 60 mils | 4.85E+01 | 2.13E+00 | 1.68E+01 | 6.74E+01 |
| EPDM (NR) 90 mils | 7.69E+01 | 3.34E+00 | 2.60E+01 | 1.06E+02 |
| Non-Renewable Primary Resources as Material (NRPR_M) [MJ] | | | | |
| EPDM (NR) 45 mils | 5.67E+01 | 0.00E+00 | 5.89E-01 | 5.73E+01 |
| EPDM (NR) 60 mils | 7.71E+01 | 0.00E+00 | 8.07E-01 | 7.80E+01 |
| EPDM (NR) 90 mils | 1.19E+02 | 0.00E+00 | 1.23E+00 | 1.21E+02 |
| Secondary Materials (SM) [kg] | | | | |
| EPDM (NR) 45 mils | 0.00E+00 | 0.00E+00 | 4.72E-02 | 4.72E-02 |
| EPDM (NR) 60 mils | 0.00E+00 | 0.00E+00 | 6.52E-02 | 6.52E-02 |
| EPDM (NR) 90 mils | 0.00E+00 | 0.00E+00 | 1.02E-01 | 1.02E-01 |
| Renewable Secondary Fuels (RSF) [MJ] | | | | |
| EPDM (NR) 45 mils | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| EPDM (NR) 60 mils | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| EPDM (NR) 90 mils | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| Non-Renewable Secondary Fuels (NRSF) [MJ] | | | | |
| EPDM (NR) 45 mils | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| EPDM (NR) 60 mils | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |
| EPDM (NR) 90 mils | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |

The waste generation associated with the non-reinforced roofing membrane is presented below in Table 5 for the production stage (A1-A3).

Table 5: Output flows & waste categories for 1m² of Non-Reinforced EPDM Single Ply Roofing Membrane

| Indicator | A1 | A2 | A3 | Total |
|---|----------|----------|----------|----------|
| Hazardous Waste Disposed (HWD) [kg] | | | | |
| EPDM (NR) 45 mils | 1.34E-07 | 1.31E-10 | 1.40E-08 | 1.48E-07 |
| EPDM (NR) 60 mils | 1.77E-07 | 1.71E-10 | 1.92E-08 | 1.96E-07 |
| EPDM (NR) 90 mils | 2.77E-07 | 2.68E-10 | 3.01E-08 | 3.07E-07 |
| Non-Hazardous Waste Disposed (NHWD) [kg] | | | | |
| EPDM (NR) 45 mils | 4.83E-02 | 1.39E-04 | 4.83E-02 | 9.68E-02 |
| EPDM (NR) 60 mils | 6.15E-02 | 1.83E-04 | 6.05E-02 | 1.22E-01 |
| EPDM (NR) 90 mils | 9.53E-02 | 2.88E-04 | 9.50E-02 | 1.91E-01 |
| Radioactive Waste Disposed (RWD) [kg] | | | | |
| EPDM (NR) 45 mils | 7.26E-04 | 4.49E-06 | 7.75E-04 | 1.50E-03 |
| EPDM (NR) 60 mils | 9.48E-04 | 5.84E-06 | 1.00E-03 | 1.96E-03 |
| EPDM (NR) 90 mils | 1.48E-03 | 9.17E-06 | 1.55E-03 | 3.04E-03 |



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LCA INTERPRETATION

The cradle-to-gate potential environmental impacts of EPDM products are driven by the raw materials (A1). Inbound transport to manufacturing (A2) and membrane manufacturing (A3) contribute to potential environmental impacts on a smaller order of magnitude.

Disclaimer (quoted from sub-category PCR):

Emerging LCA impact categories and inventory items are still under development and can have high levels of uncertainty that preclude international acceptance pending further development. Use caution when interpreting data in these categories:

- renewable primary energy resources as energy (fuel), (RPRE);
- renewable primary resources as material, (RPRM);
- non-renewable primary resources as energy (fuel) ,(NRPRE);
- non-renewable primary resources as material (NRPRM);
- secondary materials (SM);
- renewable secondary fuels (RSF);
- non-renewable secondary fuels (NRSF);
- hazardous waste disposed;
- non-hazardous waste disposed;
- Radioactive Waste Disposed (RWD);

REFERENCES

NSF International. (2019). *Product Category Rule Environmental Product Declarations, PCR for Single Ply Roofing Membrane*.

ISO. (2006). *ISO 14025: Environmental labels and declarations - Type III environmental declarations - Principles and procedures*. Geneva: International Organization for Standardization.

ISO. (2017). *ISO 21930: Sustainability in buildings and civil engineering works -- Core rules for environmental product declarations of construction products and services*. Geneva: International Organization for Standardization.

ISO. (2020a). *ISO 14040/Amd.1:2020: Environmental management – Life cycle assessment – Principles and framework*. Geneva: International Organization for Standardization.

ISO. (2020b). *ISO 14044:2006/Amd.1:2017/Amd.2:2020 Environmental management – Life cycle assessment – Requirements and guidelines*. Geneva: International Organization for Standardization.



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Sphera. (2021). *GaBi LCA Database Documentation*. Retrieved from Sphera: <http://www.gabi-software.com/support/gabi/gabi-database-2021-lci-documentation/>

CONTACT INFORMATION

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LCA PRACTITIONER



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