

ENVIRONMENTAL PRODUCT DECLARATION

According to ISO 14025 and ISO 21930:2017

NON-REINFORCED EPDM MEMBRANE

CARLISLE CONSTRUCTION MATERIALS (CCM)



About CCM

More than a half century ago, Carlisle revolutionized the commercial roofing industry with its EPDM membrane, establishing a track record of superior performance and quality that would become the company's hallmark. Today, more than 260,000 warranted Carlisle EPDM roof systems comprising over 17.5 billion square feet of membrane have been installed around the world. The history of Carlisle is built on EPDM, a preferred membrane choice of consultants, contractors, architects, and building owners in numerous areas. Since the beginning, Carlisle's attention has been devoted to the four pillars of success that customers value most: performance, energy efficiency, environmental sustainability, and innovation. These are the foundation of Carlisle's success and commitment to every customer. Carlisle's decades-long experience with EPDM has allowed the company to define the standards of quality and reliability.



Issue Date: 17-05-2023

Valid Until: 16-05-2028

Declaration Number: ASTM-EPD426

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DECLARATION INFORMATION

Declaration	
Program Operator: ASTM International Company: Carlisle Construction Materials 1285 Ritner Hwy Carlisle, PA 17013 www.carlisleconstructionmaterials.com	 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)	Period of Validity: This declaration is valid for a period of 5 years from the date of publication. Geographic Scope: North America
PCR Reference: - Core PCR: ISO 21930:2017 (ISO, 2017) - Sub-category PCR: Product Category Rules for Single-Ply Roofing Membranes (NSF International, 2019)	PCR Review was conducted by: - 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 membranes representative of 45-, 60-, and 90-mil thicknesses are used as a roofing protective layer for building applications.	
Content of the Declaration	
- 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	
This declaration was independently verified in accordance with ISO 21930:2017, ISO 14025:2006 and the reference PCR by Tim Brooke, ASTM International.	☐ Internal ☒ External
This life cycle assessment was independently verified in accordance with ISO 21930:2017 and ISO 14044:2006 and the reference PCR by Lindita Bushi, Ph.D., Athena Sustainable Materials Institute.	
Limitations: <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 Carlisle Construction Materials (CCM) 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 are 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 CCM's average production of EPDM, normalized to 1 m².



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GENERAL INFORMATION

DESCRIPTION OF COMPANY/ORGANIZATION

Carlisle SynTec Systems, the flagship division of Carlisle Construction Materials (CCM), is the largest supplier of commercial roofing products in the world. Carlisle produces high-performance EPDM, TPO, PVC, and FleeceBACK® single-ply roofing membranes, a full line of polyiso and expanded polystyrene insulation, and a wide variety of solvent-based and low-VOC adhesives. With decades of manufacturing experience and billions of square feet of roofing materials sold, Carlisle continues to lead the industry by providing the best products, services, and warranty options available today.

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 CCM. See Table 1 for membrane specification and standard.

Table 1 Roofing Membrane specification and standard

Roof System	Roof System Component	Declared Thicknesses and Weights	Standard
Non-reinforced ethylene propylene diene monomer (EPDM)	Membrane	45 mils: 1.30 kg/m ² 60 mils: 1.74 kg/m ² 90 mils: 2.75 kg/m ²	ASTM D4637

PRODUCT AVERAGE

The 2019 production data used in this EPD considers non-reinforced EPDM roofing membranes produced by CCM in two (2) sites in North America during the year. The participating facilities are:

- Carlisle, PA
- Greenville, IL

Results are weighted based on the production totals at participating facilities.

APPLICATION

Non-reinforced EPDM membranes are utilized in fully adhered and ballasted commercial roofing systems and are known to provide excellent long-term weatherability, hail resistance, and repairability. The thicker 60-mil and 90-mil membranes provide added weathering material and added puncture resistance, making them the natural choice for longer-term performance. Non-reinforced EPDM membrane is sold with factory-applied splice tape creating a very reliable and productive means to adjoin the sheets on the roof. They are also available in either light or dark colors to fit different geographic climates. Darker-colored EPDM is typically preferred in heating-dominated central and northern climates, whereas white or lighter-colored EPDM is typically preferred in cooling-dominated southern climates.

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)	33.9
Filler	20.8
Paraffinic oil	17.1
Pigment	20.3
EPDM scrap (internal)	3.1
Fire retardant	2.3
Others	2.5

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, trimmed, and rolled up into a master roll. Uncured EPDM trimmings generated during the aforementioned steps can be looped directly back as a material input. Vulcanization entails master rolls of membrane being wrapped and placed into a pressurized oven to crosslink and cure the membrane. Once cured, the membrane sheet maintains its shape and size. After vulcanization, the cured EPDM membrane is cut to the desired width and packaged onto a cardboard core.

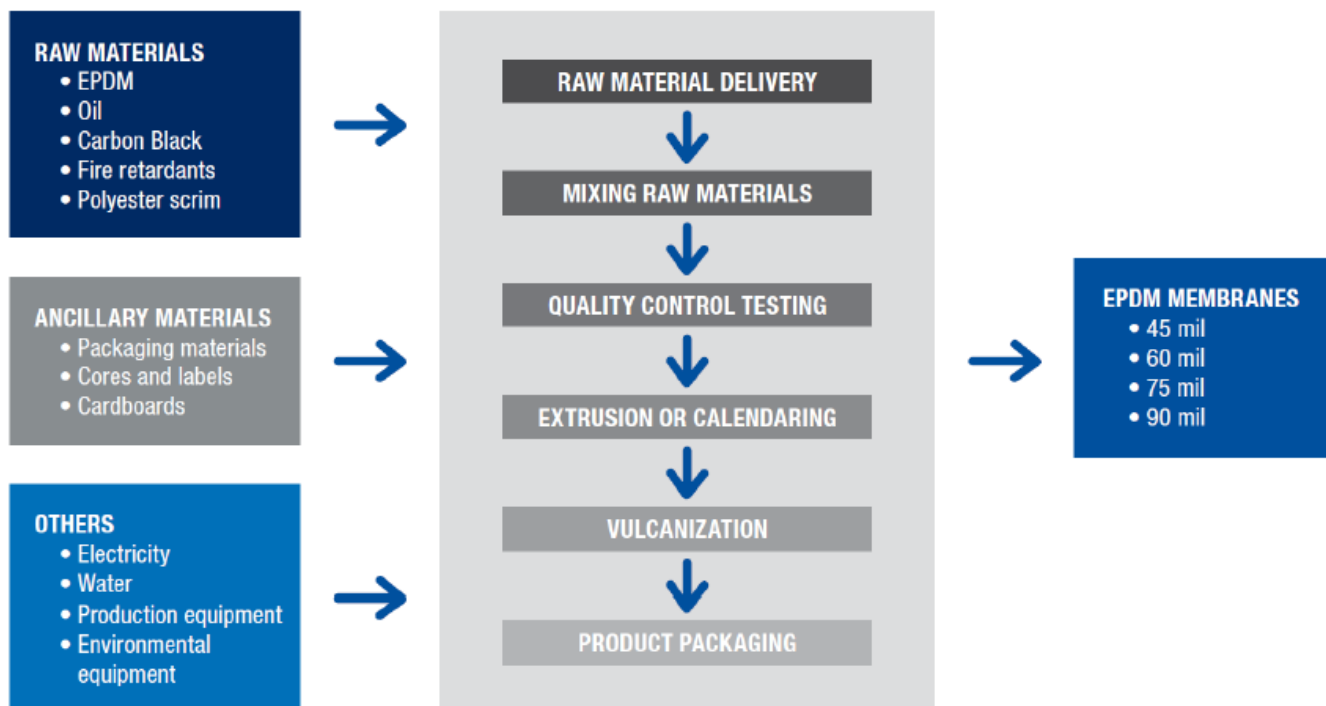


Figure 1: EPDM production process map

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.

Recycling – Carlisle has increased the level of internal recycled content used in its non-reinforced EPDM membranes and



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continues to research means to further increase the use of recycled materials into the membrane and various rubber-related accessory products like rubber pavers and walkway pads.

Energy efficiency – As a leader in the commercial roofing industry and the largest manufacturer of both white and dark-colored roofing membranes, Carlisle continues to advocate for careful selection of roofing systems based on a building's design, location, and climatic conditions. In general, the heating penalty of white reflective membranes exceeds the cooling benefit in heating-dominated central and northern climates. In the central and northern climates, heating costs are typically 3-5 times greater than cooling costs, and in these climates a dark-colored EPDM roof is typically the energy-efficient choice. In cooling-dominated southern climates, a white EPDM roof or a ballasted EPDM roof are typically the energy-efficient choice.

The use of insulating ½" cover boards provide an added 2.5 R-value as another means to enhance the energy efficiency of roofing systems. Cover boards also improve the durability and wind uplift resistance of the roofing assembly.

Specifying the use of multiple layers of insulation with staggered joints in lieu of a single thick layer of insulation is proven to be more thermally efficient.

Utilizing urethane insulation adhesives to bond insulation to the roof deck in lieu of metal fasteners and metal insulation plates eliminates the R-value loss from thermal bridging.

DISPOSAL

Product disposal is outside the scope of this EPD.

EPDM membrane, insulation, and stone from aged ballasted roof systems can be repurposed or recycled.

METHODOLOGICAL FRAMEWORK

DECLARED UNIT

The declared unit for this study is:

1 m² of single-ply roofing membrane for a stated product thickness

Environmental performance results therefore represent CCM's 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 1 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 shall be included in the inventory and the cut-off rules do not apply to such substances.

No cut-off criteria 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, 2022). Background life cycle inventory data for raw materials and processes were obtained from the GaBi 2022.2 database. 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 production at CCM facilities within North America. As such, the geographical coverage for this study is based on North American 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 2018-2021.

ALLOCATION

As several products are often manufactured at the same plant, participating facilities 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 2022 databases is documented online at <http://www.gabi-software.com/support/gabi/gabi-database-2022-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 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	3.20E+00	1.11E-01	6.05E-01	3.92E+00
EPDM (NR) 60 mils	4.76E+00	1.77E-01	8.51E-01	5.78E+00
EPDM (NR) 90 mils	8.38E+00	3.31E-01	1.41E+00	1.01E+01
Ozone Depletion Potential [kg CFC-11 eq.]				
EPDM (NR) 45 mils	4.07E-14	2.15E-16	1.23E-12	1.27E-12
EPDM (NR) 60 mils	6.07E-14	3.38E-16	1.38E-12	1.44E-12
EPDM (NR) 90 mils	1.07E-13	6.28E-16	1.65E-12	1.76E-12
Acidification Potential [kg SO₂ eq.]				
EPDM (NR) 45 mils	5.27E-03	5.28E-04	6.15E-04	6.42E-03
EPDM (NR) 60 mils	7.86E-03	9.55E-04	8.97E-04	9.71E-03
EPDM (NR) 90 mils	1.39E-02	1.98E-03	1.55E-03	1.74E-02
Eutrophication Potential [kg N eq.]				
EPDM (NR) 45 mils	5.38E-04	4.50E-05	7.60E-05	6.60E-04
EPDM (NR) 60 mils	8.09E-04	7.56E-05	1.03E-04	9.89E-04
EPDM (NR) 90 mils	1.44E-03	1.48E-04	1.65E-04	1.75E-03
Smog Formation Potential [kg O₃ eq.]¹				
EPDM (NR) 45 mils	9.25E-02	1.34E-02	1.14E-02	1.17E-01
EPDM (NR) 60 mils	1.38E-01	2.40E-02	1.63E-02	1.78E-01
EPDM (NR) 90 mils	2.43E-01	4.95E-02	2.74E-02	3.20E-01

¹ Per ISO 21930, TRACI Smog Formation Potential (SFP) is reported instead of Photochemical Oxidant Creation Potential (POCP)

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 (RPRE) [MJ]				
EPDM (NR) 45 mils	2.16E+00	6.28E-02	1.45E+00	3.68E+00
EPDM (NR) 60 mils	3.24E+00	9.84E-02	2.08E+00	5.42E+00
EPDM (NR) 90 mils	5.76E+00	1.82E-01	3.52E+00	9.47E+00
Renewable Primary Resources as Material (RPRM) [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 Primary Resources as Energy (fuel) (NRPRE) [MJ]				
EPDM (NR) 45 mils	6.93E+01	1.63E+00	8.63E+00	7.95E+01
EPDM (NR) 60 mils	1.03E+02	2.59E+00	1.28E+01	1.18E+02
EPDM (NR) 90 mils	1.80E+02	4.83E+00	2.27E+01	2.07E+02
Non-Renewable Primary Resources as Material (NRPRM) [MJ]				
EPDM (NR) 45 mils	2.02E+01	0.00E+00	1.74E-01	2.03E+01
EPDM (NR) 60 mils	3.01E+01	0.00E+00	2.42E-01	3.04E+01
EPDM (NR) 90 mils	5.34E+01	0.00E+00	3.98E-01	5.38E+01
Secondary Materials (SM) [kg]				
EPDM (NR) 45 mils	0.00E+00	0.00E+00	7.14E-02	7.14E-02
EPDM (NR) 60 mils	0.00E+00	0.00E+00	7.96E-02	7.96E-02
EPDM (NR) 90 mils	0.00E+00	0.00E+00	9.36E-02	9.36E-02
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	2.72E-09	6.76E-12	1.98E-08	2.25E-08
EPDM (NR) 60 mils	4.07E-09	1.07E-11	2.23E-08	2.63E-08
EPDM (NR) 90 mils	7.20E-09	1.99E-11	2.66E-08	3.37E-08
Non-Hazardous Waste Disposed (NHWD) [kg]				
EPDM (NR) 45 mils	3.44E-02	1.40E-04	2.61E-01	2.95E-01
EPDM (NR) 60 mils	5.21E-02	2.20E-04	4.76E-01	5.28E-01
EPDM (NR) 90 mils	9.33E-02	4.09E-04	9.94E-01	1.09E+00
Radioactive Waste Disposed (RWD) [kg]				
EPDM (NR) 45 mils	6.76E-04	4.43E-06	6.13E-04	1.29E-03
EPDM (NR) 60 mils	1.00E-03	7.00E-06	8.89E-04	1.90E-03
EPDM (NR) 90 mils	1.77E-03	1.30E-05	1.53E-03	3.31E-03

LCA INTERPRETATION

The major contributor for almost every impact is raw materials (A1) followed by manufacturing (A3) and inbound transportation (A2). The exception is ODP, which is dominated by manufacturing (A3) due to the manufacturing of bio-based packaging materials.

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);



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- Renewable secondary fuels (RSF);
- Non-renewable secondary fuels (NRSF);
- Hazardous waste disposed;
- Non-hazardous waste disposed;
- Radioactive waste disposed (RWD);

The EPDs are comparable only if they comply with the document ISO 21930, use the same sub-category PCR where applicable, include all relevant information modules and are based on equivalent scenarios with respect to the context of construction works.

ADDITIONAL ENVIRONMENTAL INFORMATION

Proven weatherability – One of the major themes in commercial construction is sustainability or long-term service life. Physical property testing of 30-year-old EPDM taken from performing roofs showed the tensile strength and tear resistance actually improved with age. It is important to note that the 30-year-old membrane was still very pliable, flexible, and didn't lose its ability to expand and contract with building movement or large temperature changes. Another important attribute is the membrane is still "repairable", meaning it can still be spliced with primers and pressure-sensitive flashings to further extend the life of the roof.

UV resistance – EPDM has excellent UV resistance as evidenced in the ASTM G155 Accelerated Xenon Arc Weathering test. Black non-reinforced EPDM has approximately twice the UV resistance of various white roofing membranes (40,000 kJ/m² compared to 20,000 kJ/m²).

Amount of weathering material – Non-reinforced EPDM membrane has over twice the weathering material thickness as an internally reinforced thermoset (EPDM) or thermoplastic (TPO & PVC) membrane. In a 60-mil non-reinforced EPDM there are 60 mils of weathering material. In a 60-mil internally reinforced membrane, there are only 20 to 24 mils of weathering material over the scrim. The mode of eventual failure on reinforced membranes is typically when the scrim begins showing through the surface of the membrane and begins taking on water.

Puncture resistance – Thicker membranes like 60-mil and 90-mil non-reinforced provide more puncture resistance than 45-mil. Adding internal reinforcement to the membrane increases the puncture resistance compared to a non-reinforced membrane. Adding external fleece reinforcement gives you the highest amount of puncture resistance and provides a full 45, 60, or 90 mils of weathering membrane above the fleece reinforcement.

Resistance to unwanted biological growth – All of Carlisle's EPDM roofing membranes provide excellent resistance to unwanted biological growth on the surface of the membrane. In the ASTM G21 test, Carlisle's EPDM membranes achieved a zero or "no growth" rating.

Resistance to hail damage – EPDM roofing membranes have a great track record of resisting hail damage and keeping water out of buildings, which can cut down on owners' financial losses considerably. Non-reinforced EPDM's ability to elongate over 400% is one of the primary reasons EPDM has great hail resistance. EPDM stays flexible throughout its life cycle, providing good hail resistance even at the end of its warranty term. Adhered systems with a minimum 60-mil non-reinforced EPDM membrane have been shown to resist up to 3" simulated hail impact without fracture or damage to the



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membrane regardless of whether the membrane was new, heat-aged, or field-weathered for 15 years. A 2009 report prepared by Jim Koontz and Tom Hutchinson states, "The results of this research clearly indicate that non-reinforced EPDM... offers a high degree of hail resistance... field- and heat-aged EPDM membrane... retains the bulk of its impact resistance as it ages" (Koontz & Hutchinson, 2009). Ric Vitiello of Benchmark Services, another veteran of roofing industry hail research, has documented his findings in a 15-page report he prepared for the EPDM Roofing Association in 2007. He commented, "Based on field and test data, it is clear that EPDM outperforms other roof systems." Vitiello additionally stated, "EPDM systems are much more hail-resistant even without special treatment" (Vitiello, 2007).

Resistance to condensation within the roofing assembly – Dark-colored EPDM membrane provides a safety factor against condensation within the roofing assembly. Scientists at Oak Ridge National Laboratory and the Chalmers University of Technology published the results of their experiments in a paper titled, "Condensation Risk of Mechanically Attached Roof Systems in Cold Climate Zones" (Manfred & Pallin, 2013). "The results emphasize the importance of solar reflectance at the roof surface. Comparing the maximum condensate layer thickness [...] reveals that the amount of accumulated moisture is almost doubled in a cool roof construction compared to a traditional black roof. Further, a cool roof will accumulate approximately twice as much moisture below the surface membrane as a black surface." This study indicates that roofing system performance can begin to be compromised when condensation accumulation exceeds 1mm. Black EPDM membrane in a mechanically fastened system is a significant safety factor with regards to minimizing condensation issues.

Pollution abatement equipment – The Carlisle plant employs pollution abatement equipment, including scrubbers, filter boxes, and dust collectors, whereas no such equipment is present in the Greenville plant.

Clarification regarding hazardous substances in the final product – Per EPDM Safety Data Sheet (SDS), the finished product declared in this EPD is considered "Articles" as defined in OSHA Hazardous Communication Standard. This finished product is not hazardous and does not contain any regulated substances of very high concern. No components in the product are listed under the SDS Section 15 Regulatory Requirements, specifically U.S. Federal Regulations, SARA Section 311/312, California Prop 65, or the Canadian WHMIS IDL. Information on ingredients and regulatory information can be found in the SDS.

Clarification regarding release of dangerous substances from the final product – The finished product declared in the EPD is classified as an article with no release of dangerous substances.

Clarification regarding hazardous waste generated during production – No hazardous waste is generated during the production of the product declared in this EPD.

REFERENCES

- ASTM International. (2020). *ASTM Program Operator for Product Category Rules (PCR) and Environmental Product Declarations (EPDs), General Program Instructions, Version: 8.0, revised 04/29/20.* .
- ASTM International. (2021). *ASTM D4637/D4637M-15(2021)e1: Standard specification for EPDM sheet used in single-ply roof membrane.*
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ENVIRONMENTAL PRODUCT DECLARATION

According to ISO 14025 and ISO 21930:2017

Non-Reinforced EPDM Single-Ply Roofing Membrane

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