

ROOFING ENVIRONMENTAL PRODUCT DECLARATION - CRADLE-TO-GRAVE SARNAFIL S 327





Sarnafil®

BUILDING TRUST

GENERAL INFORMATION

COMPANY

Sika Corporation – Roofing

PRODUCT TYPE

Single Ply Roofing Membrane

PRODUCT

Sarnafil S 327 roofing membrane, with a finished thickness of 60 mils, 72 mils or 80 mils.

MANUFACTURING SITE

Canton, MA 02021

EPD SCOPE

Cradle-to-Grave

EPD LIMITATIONS

- EPDs from different programs (using different PCR) may not be comparable
- Declarations based on the ASTM SPRM PCR can be used to assist in comparative assertions only with cradle-to-grave assessments with the same product function and functional unit and on the basis of clearly defined scenarios.

FUNCTIONAL UNIT

1,000 $m^{\rm 2}$ installed for 60 years, Sarnafil S 327

STANDARDS

The three declared Sarnafil S 327 roofing membrane thicknesses (60, 72 and 80 mils) meet the following standards and requirements

- ASTM D4434
- ENERGY STAR[®] Listed*
- Title 24 Compliant*
- Cool Roof Rating Council Listed*
- FM Approval
- Miami-Dade County Approval
- Underwriters Laboratory Inc.
- Underwrites Laboratories of Canada
- NSF/ANSI 347 Sustainability Assessment for Single Ply Roof Membranes - Platinum

*White, Tan, Reflective Gray only

ORGANIZATION

Sika Corporation, based in Lyndhurst, NJ, is a leading manufacturer of products and systems for the construction and motor vehicle markets.

Sika Corporation's roofing division has more than 50 years of experience manufacturing high quality, thermoplastic (PVC), single-ply roofing and waterproofing systems for the nonresidential market. Sika is also the first roofing manufacturer to be rated "Platinum" according to NSF/ANSI 347, the leading consensus sustainability standard.

PRODUCT DESCRIPTION AND USE

With a track record of performance of over 50 years, Sarnafil roofing membranes are the products of choice for architects, specifiers and building owners who want the peace of mind that comes with buying from the performance leader.

Sarnafil S 327 roof membrane is a thermoplastic PVC membrane used in mechanically attached systems. Sarnafil S 327 is polyester reinforced, which provides the high breaking and tearing strength needed to prevent excessive elongation and sheet deformation under the stresses produced by the wind uplift of the membrane in this type of system. A unique lacquer coating is applied to the top surface of the membrane which helps to reduce soiling.

Sika's Thickness Guarantee Program for all Sarnafil branded membranes guarantees they meet or exceed the labeled thickness, rather than following industry standards, which allows for membranes to be manufactured up to 10% below advertised thickness.

INSTALLATION

The Sarnafil S 327 membranes are rolled out on a suitable substrate, aligned and mechanically attached with steel fasteners. For the EPD calculations, the total mass of steel fasteners and seam plates was calculated as the average of five locations with different climatic conditions. The length of the screws was adjusted for each location to accommodate the thickness of insulation required by code (screw thickness ranging from 125 mm (5 in) to 200 mm (8 in)). The resulting average total mass of screws and seam plate is 0.0931 kg/m².



(5) Sarnafil S 327 Membrane



USE PHASE

In case of Sarnafil S 327 membranes, it is assumed that neither maintenance, refurbishment nor repair is required for the roofing system. Thus, the use phase only includes replacement. With a reference service life of 35 years, this implies one additional application of 1,000 m² of membrane plus overlaps and fixation are required to reach the building service life of 60 years.

The reference service life of 35 years of Sarnafil S 327 roofing membrane has been reviewed by the Athena Sustainable Materials Institute based on Sika's product performance data from various sites across North America and a thorough review of various research and certification documents. This reflects the high resistance to weathering and aging of the product when properly installed and used.

PRODUCT SPECIFICATIONS

END OF LIFE

Sarnafil S 327 roofing membranes are recycled back into new Sika membranes at the end of the use stage. As the membrane is mechanically fixed, it can easily be separated from the remaining components. Within Sika's Roof Recycling Program introduced in 2008, the company will accept a building owner's existing PVC roofing membrane for recycling with the purchase of a new Sika roofing system. Sika will also take back the newly installed PVC roofing system for recycling at the end of its service life.

Thanks to Sika's Roof Recycling Program, over 57 million pounds of vinyl roofing membranes have been diverted from landfills to date. Based on Sika's established program, a 100% recycling scenario was deemed appropriate for the EPD. Input data on the recycling process was obtained from the contracted external processing company.

ASTM D4434 VALUE/TEST RESULTS ASTM TEST **TECHNICAL DATA** UNITS TYPE III METHOD REQUIREMENT 60 MILS 72 MILS 80 MILS Weight [kg/m²] 2.0 2.4 2.6 Total Recycled Content [%] 10 (both pre- and post-consumer)¹ Reinforcing Material _ _ Polyester _ **Overall Thickness** [mil] D751 45 60 72 80 Reflectivity [%] ASTM C1549 0.84² - 0.76³ [%] ASTM C1371 0.862 - 0.853 Emissivity _ Solar Reflective Index (white) 105² - 93³ [lbf/in] Breaking Strength (M.D.), min. D751 200 (35) 305 315 325 (KN/m) Elongation at Break, min. _ D751 Machine Direction [%] 15 28.5 29 29.5 [%] **Cross Direction** 29.5 30 30.5 15 Seam Strength, min., (% of original)⁴ [%] D751 75 Pass [%] Retention of Properties After Heat Aging D3045 _ _ Tensile Strength, min., (% of original) [%] D751 90 Pass [%] D751 Elongation, min., (% of original) 90 Pass Tearing Strength (C.D.), min [lbf] (N) D1004 45 (200) 48 48.5 49 Pass Low Temperature Bend, -40 °F (-40 °C) D2136 Pass Accelerated Weathering Test (Fluorescent G154 5.000 hours 10.000 hours Light, UV exposure) Cracking (7x magnification) None None None Discoloration (by observation) Negligible Negligible Negligible None Crazing (7x magnification) None None [%] Linear Dimensional Change (C.D.), % D1204 0.5 max. -0.12 -0.13 -0.14 Weight Change After Immersion in Water, % [%] D570 ±3.0 max. 2 1.8 1.8 [lbf] (kg) Static Puncture Resistance D5602 33 Pass Dynamic Puncture Resistance [ft-lbf] (J) D5635 14.7 Pass

¹ Pre-consumer material: roofing membrane trimmings from Sika's manufacturing process and market supplied post-industrial PVC scrap material. Post-consumer material: Sika Sarnafil and other PVC roofing material at the end of its service life (total average recycled content: minimum 10%)

² New Membrane

³ 3 year aged membrane

⁴ Failure occurs through membrane rupture not seam failure

Life Cycle Stages

STAGES INCLUDED IN THIS LIFE CYCLE ASSESSMENT (LCA)



SYSTEM BOUNDARY

INCLUDED	
A1-A3	 Extraction and processing of raw materials, including fuels used in product manufacturing; Transportation of raw materials including empty backhauls; Manufacturing of the product; Packaging of the product ready for shipment; Transportation from the manufacturing site to recycling/reuse for pre-consumer waste and unutilized byproducts from manufacturing, including empty backhauls; and Recycling/reuse of pre-consumer waste and by-products of production.
A4-A5	 Transportation of product from manufacturing site to building site, including empty backhauls; Installation on the building site including steel fasteners (0.0931 kg/m²) for a mechanically attached application; and Disposal (landfill) of waste produced on the building site.
B1-B7	 Reference service life of the building is assumed to be 60 years according to the PCR and the number of replacements of the building product are declared accordingly (note that an assumed 60-year reference service life for the building is the accepted time period for the purpose of comparative analysis); Any replacement of the building product (B4) required to attain the reference service life of the building based on a verifiable product performance history; As the product reference service life (35 years) is less than the assumed building service life (60 years), the aggregated product stage, construction process stage and end of life stage impacts (modules A1 – A5 and C1 – C4) associated with the number of roof replacements necessary to equal the service life of the building are included; The combined impacts of the original product and any roof replacements are determined by dividing the building service life (60 years) by the service life of the product, and the impacts are multiplied by the result. In this case, the impacts are multiplied by 1.7, thus normalizing the roof replacements during the assumed 60-year building service life. It is assumed that no use inputs/outputs (B1), maintenance (B2), repair (B3), refurbishment (B5) or operational water (B6) and energy (B7) use is required for the roofing system.
C1-C4	 Dismantling/demolition of the roof system (assumed to be carried out manually using hand tools); Average transport from building site to recycling (membrane)/landfill (fasteners), including empty backhauls; and Recycling/landfilling processes.
NOT INCLUDED	

MATERIAL CONTENT DECLARATION

The material average percentage by weight for 1 m² for the Sarnafil S 327 60, 72 and 80 mils is provided.

MATERIAL AVERAGE PERCENTAG SARNAFIL S 327 60, 72	PACKAGING MATERIAL	DECLARED PRODUCT [MILS]			
RAW MATERIAL INPUT	TOTAL WEIGHT BY [%]		60	72	80
PVC resin new material	42	Cardboard Core [kg]	0.05	0.05	0.05
PVC resin recycled content	13	Wooden pallet [kg]	0.13	0.22	0.22
Plasticizer	27	PE Film [kg]	0.005	0.006	0.006
Polyester fabric (scrim reinforcement)	4				
Rest of chemicals	14				
Total weight (Input)	100	Total [kg/m²]	0.18	0.27	0.27

LIFE CYCLE IMPACTS

The results displayed below apply to Sarnafil S 327 with a thickness of 60 mils, 72 mils and 80 mils.

The credit for displaced production of primary plasticized PVC resin considers the amount of recycled PVC material in the end of life stage available for use in another system. The credit is calculated as the environmental impact of producing a corresponding amount of plasticized PVC. The amount of external post-consumer PVC material used in the product is not included in the credit to avoid double-counting. The total does not include the credit for displaced PVC production.

RESULTS SARNAFIL S 327 [60 MILS]	FUNCTIONAL UNIT OF 1,000 M ² INSTALLED MEMBRANE					
CATEGORY INDICATOR	TOTAL	PRODUCT STAGE	CONSTRUCTION STAGE	USE STAGE	END OF LIFE STAGE	CREDIT FOR DISPLACED PVC PRODUCTION
		A1-A3	A4-A5	B4	C1-C4	
Global Warming Air, incl. biogenic carbon [kg CO ₂ -eq.]	1.22E+04	5.57E+03	1.00E+03	5.08E+03	5.37E+02	-6.12E+03
Acidification Potential [kg SO ₂ -eq.]	1.01E+02	5.00E+01	6.21E+00	4.19E+01	2.45E+00	-8.37E+01
Eutrophication Potential [kg N-eq.]	2.48E+00	9.59E-01	3.67E-01	1.03E+00	1.18E-01	-1.19E+00
Smog Creation Potential [kg O_3 -eq.]	7.17E+02	3.12E+02	6.99E+01	2.99E+02	3.64E+01	-4.04E+02
Ozone Depletion Potential [kg C_2H_4 -eq.]	1.25E-04	6.84E-05	4.38E-06	5.22E-05	2.31E-07	-2.50E-04
TOTAL PRIMARY ENERGY CONSUMPTION ⁵						
Non-renewable fossil [MJ]	2.69E+05	1.35E+05	1.51E+04	1.12E+05	7.14E+03	-1.80E+05
Non-renewable nuclear [MJ]	1.74E+04	7.10E+03	8.12E+02	7.24E+03	2.23E+03	-6.35E+03
Renewable (solar, wind, hydropower, geothermal) [MJ]	1.26E+04	4.00E+03	7.13E+02	5.24E+03	2.63E+03	0
Renewable (biomass) [MJ]	2.54E+00	1.39E+00	8.88E-02	1.06E+00	0	0
MATERIAL RESOURCES CONSUMPTION ⁶						
Non-renewable materials [kg]	3.03E+03	1.66E+03	1.06E+02	1.26E+03	0	-3.33E+03
Renewable materials [kg]	3.19E+02	1.75E+02	1.11E+01	1.33E+02	0	0
Fresh water [I]	8.87E+04	3.84E+04	4.25E+03	3.69E+04	9.12E+03	0
WASTE GENERATED						
Non-hazardous [kg]	8.74E+02	2.83E+02	1.31E+02	3.64E+02	9.59E+01	0
Hazardous [kg]	4.33E-05	1.99E-05	1.65E-06	1.80E-05	3.69E-06	0

⁵ Total Primary Energy includes both feedstock energy and process energy.

⁶ The nonrenewable and renewable materials were calculated by summing up the mass of the main components with high heating value.

RESULTS SARNAFIL S 327 [72 MILS]	FUNCTIONAL UNIT OF 1,000 M ² INSTALLED MEMBRANE					
CATEGORY INDICATOR	TOTAL	PRODUCT STAGE	CONSTRUCTION STAGE	USE STAGE	END OF LIFE STAGE	CREDIT FOR DISPLACED PVC PRODUCTION
		A1-A3	A4-A5	B4	C1-C4	
Global Warming Air, incl. biogenic carbon [kg CO ₂ -eq.]	1.44E+04	6.66E+03	1.11E+03	6.01E+03	6.40E+02	-7.40E+03
Acidification Potential [kg SO ₂ -eq.]	1.21E+02	6.07E+01	7.08E+00	5.05E+01	2.85E+00	-1.01E+02
Eutrophication Potential [kg N-eq.]	2.87E+00	1.15E+00	3.91E-01	1.20E+00	1.36E-01	-1.43E+00
Smog Creation Potential [kg O_3 -eq.]	8.50E+02	3.76E+02	7.92E+01	3.54E+02	4.05E+01	-4.90E+02
Ozone Depletion Potential [kg C_2H_4 -eq.]	1.53E-04	8.35E-05	5.34E-06	6.36E-05	2.79E-07	-3.02E-04
TOTAL PRIMARY ENERGY CONSUMPTION ⁵						
Non-renewable fossil [MJ]	3.21E+05	1.61E+05	1.72E+04	1.34E+05	8.50E+03	-2.18E+05
Non-renewable nuclear [MJ]	2.06E+04	8.40E+03	8.99E+02	8.57E+03	2.70E+03	-7.66E+03
Renewable (solar, wind, hydropower, geothermal) [MJ]	1.46E+04	4.57E+03	7.50E+02	6.07E+03	3.18E+03	0
Renewable (biomass) [MJ]	2.59E+00	1.42E+00	9.08E-02	1.08E+00	0	0
MATERIAL RESOURCES CONSUMPTION ⁶						
Non-renewable materials [kg]	3.72E+03	2.04E+03	1.30E+02	1.55E+03	0	-4.03E+03
Renewable materials [kg]	4.83E+02	2.65E+02	1.69E+01	2.01E+02	0	0
Fresh water [I]	1.01E+05	4.33E+04	4.75E+03	4.21E+04	1.10E+04	0
WASTE GENERATED						
Non-hazardous [kg]	1.00E+03	3.49E+02	1.40E+02	4.19E+02	9.64E+01	0
Hazardous [kg]	4.88E-05	2.22E-05	1.82E-06	2.03E-05	4.42E-06	0

 $^{\rm 5}$ Total Primary Energy includes both feedstock energy and process energy.

⁶ The nonrenewable and renewable materials were calculated by summing up the mass of the main components with high heating value.

RESULTS SARNAFIL S 327 [80 MILS]	FUNCTIONAL UNIT OF 1,000 M ² INSTALLED MEMBRANE					
CATEGORY INDICATOR	TOTAL	PRODUCT STAGE	CONSTRUCTION STAGE	USE STAGE	END OF LIFE STAGE	DISPLACED PVC PRODUCTION
		A1-A3	A4-A5	B4	C1-C4	
Global Warming Air, incl. biogenic carbon [kg CO ₂ -eq.]	1.59E+04	7.38E+03	1.17E+03	6.61E+03	7.08E+02	-8.25E+03
Acidification Potential [kg SO ₂ -eq.]	1.35E+02	6.78E+01	7.66E+00	5.61E+01	3.10E+00	-1.13E+02
Eutrophication Potential [kg N-eq.]	3.12E+00	1.27E+00	4.06E-01	1.30E+00	1.47E-01	-1.60E+00
Smog Creation Potential [kg O_3 -eq.]	9.35E+02	4.17E+02	8.51E+01	3.90E+02	4.31E+01	-5.45E+02
Ozone Depletion Potential [kg C_2H_4 -eq.]	1.71E-04	9.32E-05	5.96E-06	7.11E-05	3.11E-07	-3.37E-04
TOTAL PRIMARY ENERGY CONSUMPTION ⁵						
Non-renewable fossil [MJ]	3.54E+05	1.79E+05	1.86E+04	1.48E+05	9.38E+03	-2.43E+05
Non-renewable nuclear [MJ]	2.26E+04	9.24E+03	9.55E+02	9.43E+03	3.00E+03	-8.55E+03
Renewable (solar, wind, hydropower, geothermal) [MJ]	1.59E+04	4.94E+03	7.74E+02	6.61E+03	3.54E+03	0
Renewable (biomass) [MJ]	2.62E+00	1.44E+00	9.18E-02	1.09E+00	0	0
MATERIAL RESOURCES CONSUMPTION ⁶		_				
Non-renewable materials [kg]	4.05E+03	2.22E+03	1.41E+02	1.69E+03	0	-4.47E+03
Renewable materials [kg]	4.83E+02	2.65E+02	1.69E+01	2.01E+02	0	0
Fresh water [I]	1.09E+05	4.65E+04	4.77E+03	4.54E+04	1.23E+04	0
WASTE GENERATED						
Non-hazardous [kg]	1.09E+03	3.94E+02	1.46E+02	4.54E+02	9.68E+01	0
Hazardous [kg]	5.24E-05	2.37E-05	1.92E-06	2.18E-05	4.89E-06	0

⁵ Total Primary Energy includes both feedstock energy and process energy.

⁶ The nonrenewable and renewable materials were calculated by summing up the mass of the main components with high heating value.

Interpretation of the Results

The results for the Cradle-to-Grave assessment of Sarnafil S 327 show that most impacts come from module A1-A3 and, consequently, also from module B. Raw materials extraction and production, summed up across modules A1-3 and B, account between 54% and 93% of the impacts. The impacts from raw materials and production are particularly high for non-renewable and renewable materials, ozone depletion potential and renewable primary energy consumption from biomass (all 93%). Within A1-A3, at least 79% of the impacts come from raw materials in all impact categories. Manufacturing is the second largest contributor, while transport of raw materials to manufacturing was found to have a minor relative impact.

Additional Environmental Information

- Sarnafil roofing membranes were the first products to achieve Platinum certification to the NSF/ANSI 347 Sustainability Assessment for Single Ply Roofing Membranes.
- The Sarnafil EnergySmart[®] membrane has a highly reflective, lacquer-coated surface that can reduce cooling and overall energy consumption in conditioned buildings. Sarnafil roof membranes exceed the cool roof requirements of ENERGYSTAR,[®] California's Building Energy Code (Title 24), LEED[®] and Green Globes[®].
- Sika's Roof Recycling Program has diverted more than 57 million pounds of pre-consumer and post-consumer vinyl membrane from landfill, recycling it back into roofing and waterproofing membrane products.
- Sarnafil 5-foot and 10-foot membranes have been validated by UL Environment to contain an average of 10% recycled content.
- Sarnafil roof membranes help building owners achieve LEED and Green Globes certification.
- The reference service life of 35 years was reviewed by the Athena Sustainable Materials Institute, based on the results of various field surveys.

USE PHASE BENEFITS

- Using white, highly reflective Sarnafil roofing membranes can help reduce net annual energy consumption by reducing cooling energy use of buildings and thus reduce the operational carbon emissions over time. The estimated potential net energy savings resulting from the installation of the white, highly reflective Sarnafil roofing membrane compared to a black roof were calculated for different climatic zones (five locations) in the USA using the USEPA DOE Roof Calculator (version 1.2), developed by the U.S. Department of Energy's Oak Ridge National Laboratory. The properties of the insulation represent the minimum insulation requirements in the building codes of the different locations. The initial solar reflectance is assumed to be 84% and the initial infrared emittance is set as 86%.
- It is estimated that using white, highly reflective Sarnafil roofing membrane, about 4,146 GJ energy could potentially be saved in Miami on a roof area of 1,000 m² compared with the black colored membrane over a period of 35 years (all thicknesses). This results in avoided greenhouse gas emissions of about 228.215 t CO₂-eq. per 1,000 m² of roof surface.



Estimated cumulative potential energy savings due to the use of a white Sarnafil S 327 membrane compared with a black roof: Total Primary Energy Consumption [MJ/1,000 m²]



Duluth

Boston -Salt Lake City -

Dallas

Miami

savings due to the use of a white Sarnafil S 327 membrane compared with a black roof:

Estimated cumulative potential greenhouse gas emissions

EPD VERIFICATION

This EPD was independently verified by ASTM in accordance with ISO 14025:

Internal	External X	Lindita Bushi, Ph.D., Senior Research Associate Athena Sustainable Materials Institute 100-119 Ross Avenue Ottawa, Ontario, Canada K1Y0N6 lindita.bushi@athenasmi.org			Signed: Lindita Bushi	
Program Operator		Timothy Brooke ASTM International 100 Bar Harbor Drive West Conshohocken, PA 19428 tbrooke@astm.org		Signed: Hypoconte		
Declaration Hold	er	Sika Corporation				
Product group		Date of Issue	Period of Validity	Declaration Number		
		12/20/2017	5 years	EPD076		

DECLARATION TYPE A "Cradle-to-Grave" EPD for three selected thicknesses of the Sarnafil S 327 roofing membrane (60, 72 and 80 mils). The modules included are A1 -A3, A4- A5, B1-B7 and C1-C4. The declaration is intended for use in Business to Business (B2B) communication.	PRODUCT APPLICABILITY AND CHARACTERISTICS The declared Sarnafil S 327 roofing membrane thicknesses (60, 72 and 80 mils) are designed for low-slope and steep slope roofing applications. The membranes include an internal polyester reinforcement to provide the tear resistance required for mechanically- fastened roof systems.	CONTENT OF THE DECLARATION This declaration follows Section 11, Content of the EPD, ASTM International Product Category Rules for Preparing an Environmental Product Declaration for Single-Ply Roofing Membranes, January 2016.
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EPD PROJECT REPORT INFORMATION

EPD PROJECT REPORT	A "Cradle-to-Grave" Life Cycle Assessment for three thicknesses of Sarnafil S 327 (60, 72 and 80 mils), 11/13/2017
LCA AND EPD PREPARED BY:	Global Poduct Sustainability Sika Services AG Tüffenwies 16 8048 Zürich Switzerland product.sustainability@ch.sika.com

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PCR INFORMATION

PROGRAM OPERATOR	ASTM International
REFERENCE PCR	ASTM International, Product Category Rules for Preparing an Environmental Product Declaration for Single Ply Roofing Membranes
DATE OF ISSUE	01/15/16, version 2 (version 1 issued November 2013)
PCR REVIEW WAS CONDUCTED BY:	Francois Charron-Doucet Quantis International Email: francois.charron@quantis-intl.com

GLOBAL BUT LOCAL PARTNERSHIP



WHO WE ARE

Sika AG, located in Baar, Switzerland, is a specialty chemicals company with a leading position in the development and production of systems and products for bonding, sealing, damping, reinforcing and protecting in the building sector and the motor vehicle industry.

The corporation has subsidiaries in 98 countries, employs more than 17,000 people worldwide, and has more than 190 manufacturing facilities around the globe.

Our most current General Sales Conditions shall apply. Please consult the Product Data Sheet prior to any use and processing. ISO 14001: 2004-Compliant



ENERGY STAR® for roofing products is only valid in the United States. ENERGY STAR® is a trademark of the U.S. EPA. LEED® is a trademark of the U.S. Green Building Council. Green Globes® is a trademark of the Green Building Initiative.



SIKA CORPORATION-ROOFING

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BUILDING TRUST

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