



Certified
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Product Declaration
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ENVIRONMENTAL PRODUCT DECLARATION

In accordance with ISO 14040:2006/AMD 1:2020, ISO 14044:2006, and ISO 21930:2017 for -

Spray Polyurethane Foam Insulation – ENERTITE® Series Open-Cell

1 m² of installed insulation material with a thickness that gives an average thermal resistance RSI = 1 m²K/W (R=5.68 hr·ft²·°F/Btu) and with a building service life of 75 years (packaging included).

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Owner of the Declaration	BASF Corporation (www.spf.basf.com)
EPD Program Operator	NSF Certification, LLC (www.nsf.org)
PCR Program Operator	UL Environment
Declaration number	EPD11121
Issue date	10/24/2025
Validity date	10/24/2030

An EPD should provide current information and may be updated if conditions change. The stated validity is therefore subject to the continued registration and publication at http://info.nsf.org/Certified/Sustain/epd_search.asp



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1.0 Program Information

EPD PROGRAM OPERATOR

NSF Certification LLC
789 N. Dixboro,
Ann Arbor, MI 48105

www.nsf.org



PCR PROGRAM OPERATOR

UL Solutions Inc. (UL)
<https://www.ul.com/resources/product-category-rules-pcrs>



EPD DECLARATION HOLDER

BASF Corporation
1703 Crosspoint
Houston, TX 77054

www.spf.basf.com



The EPD owner, BASF Corporation, has the sole ownership, liability, and responsibility for the EPD.

LCA CONSULTANT

Sphera Solutions, Inc.
130 East Randolph St., Ste. 2900
Chicago, IL 60601

www.sphera.com



2.0 General Information

EPD PROGRAM AND PROGRAM OPERATOR NAME, ADDRESS, LOGO, AND WEBSITE	NSF Certification LLC, 789 N. Dixboro Road. Ann Arbor Michigan 48105, USA www.nsf.org	
GENERAL PROGRAM INSTRUCTIONS AND VERSION NUMBER	Part A: Life Cycle Assessment Calculations and Report Requirements, Version 4.0	
MANUFACTURER NAME AND ADDRESS	BASF Corporation 1703 Crosspoint Ave. Houston, Texas 77054 USA www.spf.basf.com	
DECLARATION NUMBER	EPD11121	
DECLARED PRODUCT & FUNCTIONAL UNIT OR DECLARED UNIT	Spray polyurethane foam insulation (ENERTITE open-cell SPF), 1 m ² of installed insulation material with a thickness that gives an average thermal resistance of RSI = 1 m ² ·K/W (R = 5.68 hr·ft ² ·°F/Btu) with a building service life of 75 years (packaging included).	
REFERENCE PCR AND VERSION NUMBER	ISO 21930:2017 'Sustainability in buildings and civil engineering works — Core rules for environmental product declarations of construction products and services' - serves as the core PCR. Part A: Life Cycle Assessment Calculations and Report Requirements, Version 4.0 (2022) Per the ISO 14025 requirements, this Part A was reviewed by the following critical review panel: • Lindita Bushi (Chair), Athena Sustainable Materials Institute, lindita.bushi@athenasmi.org • Hugues Imbeault-Tétreault, Groupe AGÉCO, hugues.i-tetreault@groupeageco.ca • Jack Geibig, Ecoform, jgeibig@ecoform.com Sub-category Part B: Building Envelope Thermal Insulation EPD Requirements, Version 3.0 (2024)	
DESCRIPTION OF PRODUCT'S INTENDED APPLICATION AND USE (AS IDENTIFIED WHEN DETERMINING PRODUCT RSL)	ENERTITE spray polyurethane foam insulation used in buildings and construction across the US and Canada	
PRODUCT RSL DESCRIPTION (IF APPL.)	The reference service life (RSL) and estimated building service life (ESL) for SPF is the life of the building of 75 years.	
MARKETS OF APPLICABILITY	North America	
DATE OF ISSUE	10/24/2025	
PERIOD OF VALIDITY	10/24/2030	
EPD TYPE	Product Specific	
EPD SCOPE	Cradle to Grave	
YEAR(S) OF REPORTED MANUFACTURER PRIMARY DATA	2023	
LCA SOFTWARE & VERSION NUMBER	LCA FE 10.9 (formerly GaBi Software)	
LCI DATABASE(S) & VERSION NUMBER	Managed LCA Content 2024.2 (formerly GaBi Database, CUP2024.2)	
LCIA METHODOLOGY & VERSION NUMBER	IPCC AR6 TRACI 2.1) CML 2001 Aug 2016	

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The sub-category PCR review was conducted by	The Part B was reviewed by the following panel: • Thomas Gloria (chair), Industrial Ecology Consultants t.gloria@industrial-ecology.com • Christoph Koffler, Sphera ckoffler@sphera.com • Andre Desjarlais, Oak Ridge National Laboratory desjarlaisa@ornl.go
This declaration was independently verified in accordance with ISO 14025: 2006. The UL Environment "Part A: Calculation Rules for the Life Cycle Assessment and Requirements on the Project Report," v4.0 (August 2022), based on ISO 21930:2017, serves as the core PCR, with additional considerations from the USGBC/UL Environment Part A Enhancement (2017) ☐ INTERNAL ☒ EXTERNAL	 Jack Geibig, Ecoform
This life cycle assessment was conducted in accordance with ISO 14044 and the reference PCR by:	Sphera Solutions, Inc.
This life cycle assessment was independently verified in accordance with ISO 14044 and the reference PCR by:	 Jack Geibig, Ecoform
LIMITATIONS: Environmental declarations from different programs (ISO 14025) may not be comparable. Comparison of the environmental performance of Building Envelope Thermal Insulation using EPD information shall be based on the product's use and impacts at the building level, and therefore EPDs may not be used for comparability purposes when not considering the building energy use phase as instructed under this PCR. Full conformance with Part B of the PCR for Building Envelope Thermal Insulation allows EPD comparability only when all stages of a life cycle have been considered. However, variations and deviations are possible". Example of variations: Different LCA software and background LCI datasets may lead to differences results for upstream or downstream of the life cycle stages declared. Environmental declarations from different programs based upon differing PCRs may not be comparable. This EPD is not intended to make any comparative assertions.	

3.0 Company Information

BASF Corporation is a North American manufacturer specializing in high-performance spray polyurethane foam products primarily used for insulation and air sealing, in residential and commercial construction. The company offers a range of spray foam insulation solutions that provide excellent thermal resistance, air sealing, and soundproofing capabilities, contributing to energy efficiency and improved indoor comfort. Overall, BASF's spray foam business plays a crucial role in the company's broader mission to provide sustainable solutions and enhance the performance of buildings while addressing energy efficiency and environmental concerns. Spray polyurethane foam from BASF Corporation is formulated and developed to exceed performance criteria, no matter the climate, the code or the application.

4.0 Product Information

4.1 Product Identification

BASF ENERTITE® describes a category of low-density, open-cell spray polyurethane foam (ocSPF) insulation material used widely in North America, in residential, light commercial, commercial, and institutional applications. It provides excellent air sealing, sound absorption, and thermal insulation, making homes and buildings more energy-efficient and comfortable. ENERTITE is particularly effective in filling difficult-to-reach areas, such as corners and around pipes and wiring, ensuring a seamless seal against air movement.

TABLE 1 TYPICAL PROPERTIES OF ENERTITE OPEN-CELL SPRAY POLYURETHANE FOAM

Name	ENERTITE
Density [lb/ft ³]	0.48
Thermal resistivity [R/in]	3.73
Air impermeable material	✓
Cavity insulation	✓

All SPF products must meet numerous performance requirements to comply with building codes. The CSI code for spray foam products is 07 21 19.16 (Polyurethane Foam Insulation). The details of these requirements are described in specific tests listed in consensus standards for material performance and code compliance. ocSPF products must follow the following standards:

International Code Council Standards:

- ICC-ES AC-377 Acceptance Criteria for Spray-Applied Foam Plastic Insulation
- ICC-1100-2019 Standard for Spray-applied Polyurethane Foam Plastic Insulation

Typical material performance requirements per ICC-1100 are provided in Table 2.

TABLE 2 SUMMARY OF TYPICAL MATERIAL PERFORMANCE REQUIREMENTS FOR OCSPF IN CONSTRUCTION

Standard Type	ASTM	Open cell
Thermal Performance (R-value)	ASTM C518, C177 or C1363	As reported (typically R _{IP} 3.6-4.3/inch / 2.5-3.0/100mm)
Surface Burning Characteristics	ASTM E84 or UL723	Flame spread index ≤ 75 Smoke developed ≤ 450
Core Density	ASTM D1622	As reported (typically 0.4-1.5 pcf / 6.4-24 kg/m ³)

Tensile Strength	ASTM D1623	3 psi min (21 kPa)
Dimensional Stability	ASTM D2126	15% max change
Air Permeance	ASTM D E283 or D2178	As reported (typically impermeable @ 3-5" + / 76-127 mm)

4.2 Manufacturing Process & Flow Diagram

ENERTITE ocSPF insulation is made on the jobsite by combining ELASTOSPRAY® 8000A isocyanate (side-A) with the ENERTITE polyol blend (side-B). Sides A and B react and expand at the point of application in the building envelope to form polyurethane foam. The foamed-in-place SPF provides both thermal insulation and air sealing to the building.

There are various classes of SPF, one of them being open cell SPF (ocSPF) using reactive blowing agent, water, in side-B to react with side-A isocyanates. This declaration only covers open cell formulations from BASF.

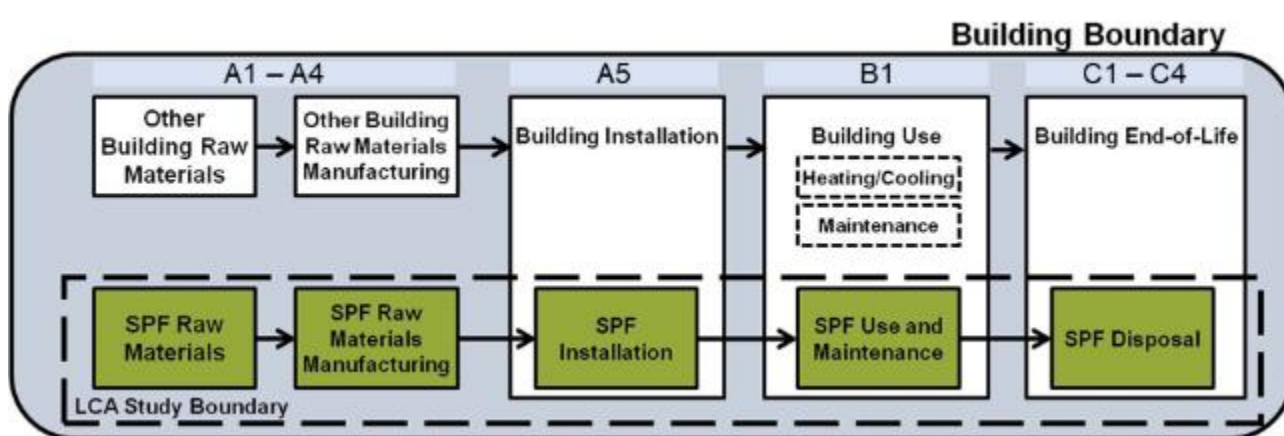


FIGURE 1 FLOW DIAGRAM OF SPRAY FOAM LIFE CYCLE

All the side A is made at Geismar, Louisiana, U.S. All the primary chemicals used in the side-B formulation are processed in a BASF facility in Houston, Texas, U.S.

During the side-B production process, materials are blended together in closed tanks and packaged. Moreover, BASF's facilities employ technology to minimize the release of low boiling point materials, such as blowing agents and catalysts, during material transfers and blending processes. Minimal waste is produced as wash materials are re-blended into the process without the need for additional collection, transport, or processing.

The two chemicals required to produce SPF (side-A and side-B) are delivered as a set to the job site in separate containers. On the job site, equal volume proportions of side A is mixed with side B (from 500 lb drums of side A and 480 lb drums of side B) to create ENERTITE SPF. A total mass of 0.30 kg (0.66 lb) of ENERTITE product per functional unit (m2) is used.

4.3 Product Average

This EPD is intended to represent the weighted average results for ENERTITE SPF product. The average is calculated based on a weighted-average formulation for side-B, combined with production data collected from BASF. The data were weighted according to the mass produced by each BASF facility in Houston, Texas, U.S. and Orange, California, U.S. The side A used for this product is ELASTOSPRAY 8000A, which is manufactured by BASF at a single facility located in Geismar, Louisiana, U.S.

4.4 Application

Open-cell spray foam is a versatile insulation material widely used in construction due to its effective thermal performance and sound attenuation properties. Its flexible structure allows it to fill gaps seamlessly, making it ideal for applications such as wall insulation, attic insulation, and interior walls, where it helps regulate indoor temperatures and control air movement. Additionally, open-cell spray foam enhances soundproofing in interior walls and ceilings, making it particularly beneficial for multi-family dwellings. Overall, open-cell spray foam is favored for its ease of application and ability to enhance comfort and energy efficiency in both residential and commercial construction.

4.5 Technical Requirements

Spray foam insulation products must be installed in compliance with building codes. Nearly all jurisdictions have adopted a version of the following building codes:

- a) International Code Council (ICC) - International Residential Code (IRC) – For 1 and 2 family dwellings
- b) International Code Council (ICC) - International Building Code (IBC) – For multifamily dwellings, as well as commercial, institutional and industrial buildings.
- c) International Code Council (ICC) - International Energy Conservation Code (IECC) – Providing envelope energy efficiency requirements for all buildings.
- d) American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) Standard 90.1- Energy Standard for Sites and Buildings Except Low-Rise Residential Buildings
- e) American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) Standard 90.2- Energy-Efficient Design of Low-Rise Residential Buildings
- f) National Research Council of Canada - National Building Code of Canada

To meet code requirements, ENERTITE must meet minimum performance requirements, demonstrated by laboratory testing using approved test methods. These tests are performed by third-party laboratories and test data typically submitted to a certification agency for evaluation of the results and the creation of an independent code compliance report for the product. Certification agencies also perform regular quality control testing from random samples taken from the manufacturer's facilities.

There are two guides that are followed by these certification bodies to collect and evaluate data to generate code compliance reports:

- ICC 1100 Standard for Spray-applied Polyurethane Foam Plastic Insulation (2019)
- IAPMO/ANSI ES1000 Building Code Compliance Spray-Applied Polyurethane Foam (2020)
- CAN/ULC-S712.1 Standard for Thermal Insulation – Light Density, Open Cell Spray Applied Semi-Rigid Polyurethane Foam – Material Specification

TABLE 3 TESTING REQUIREMENTS FOR SPF PER ICC 1100 AND IAPMO ES1000 STANDARDS

Property	Measurement	Test Method	Requirement
Thermal Resistance	R-value at thickness or thermal resistance	ASTM C177 Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus, ASTM C518 Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus, OR ASTM C1363 Standard Test Method for Thermal Performance of Building Materials and Envelope Assemblies by Means of a Hot Box Apparatus	Report
Air Permeance	Thickness where foam is air impermeable	ASTM E283/E283M Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Skylights, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen OR ASTM E2178a Standard Test Method for Determining Air Leakage Rate and Calculation of Air Permeance of Building Materials	Report minimum thickness where air impermeable
Water Vapor Permeance	Thickness where foam meets Class I, II or III vapor retarder performance	ASTM E96/E96M Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials (Method A)	Report thickness at vapor retarder class I, II or III.
Density	Mass density of foam	ASTM D1622 Standard Test Method for Apparent Density of Rigid Cellular Plastics	Report
Surface Burning Characteristics	Flame Spread Index	ASTM E84 Standard Test Method for Surface Burning Characteristics of Building Materials	75 or less
	Smoke Developed Index	ASTM E84 Standard Test Method for Surface Burning Characteristics of Building Materials	450 or less for insulation, unlimited for roofing
Thermal Barrier Testing	Pass fire test with prescriptive thermal barrier for thickness over 4"	NFPA 286, FM 4880, UL 1040 or UL1715	Pass 15 minute criteria
Alternate Thermal Barrier Assembly	Pass fire test with specific covering or coating	NFPA 286, FM 4880, UL 1040 or UL1715	Pass 15 minute criteria
Ignition Barrier Testing	Pass fire test with or without covering or coating	Various special test methods	See standard for details

TABLE 4 TYPICAL TESTING REQUIREMENTS FOR SPF PER CAN/ULC S712.1 STANDARD

Properties	Test Method	Requirements
Apparent Core Density	ASTM D1622 Standard Test Method for Apparent Density of Rigid Cellular Plastics	$\geq 6.8 \text{ kg/m}^3$ $\leq 12.0 \text{ kg/m}^3$
Air Permeance	ASTM E2178	Declare
Dimensional Stability	ASTM D2126 Standard Test Method for Response of Rigid Cellular Plastics to Thermal and Humid Aging	@20 °C: -1/+10% @80 °C: -15/+10% @70 °C: -15/+14%
28 d at -20±3°C, ambient humidity		-1 to +10%
28 d at 80±2°C, ambient humidity		-15 to 10%
28 d at 70±2°C, 97±3% R.H		-15 to +14%
Fungi Resistance	ASTM C1338	No Growth
Open-Cell Content	ASTM D6226	$\geq 80\%$
Surface Burning Characteristics	CAN/ULC-S102	<500
Thermal Resistance for 50 mm	ASTM C518	$\geq 1.20 \text{ m}^2\cdot\text{K/W}$
Time to Occupancy	CAN/ULC-S774	< 30 Days

4.6 Material Composition

The side-A of SPF is comprised of ELASTOSPRAY 8000A, an isocyanate compound manufactured by BASF at their facility located in Geismar, Louisiana, U.S. The ENERTITE side-B is a mixture of polyester and polyether polyols, flame retardants, blowing agents, catalysts, and other additives that, when mixed with side-A, creates a foam that can be applied as insulation. As the precise formulation of the side-B will vary with each BASF facility; this study uses a weighted average formulation (Table 5).

As per the Resource Conservation and Recovery Act (RCRA), Subtitle C, the spray foam product as installed and ultimately disposed of is not classified as a hazardous substance. No substances required to be reported as hazardous are associated with this construction product.

TABLE 5 AVERAGE ENERTITE SIDE-B CHEMICAL COMPOSITION (% MASS)

Chemical Components	Composition
Polyols	46.57%
Fire Retardants	19.70%
Blowing Agents	20.13%
Catalyst	11.67%
Surfactant	1.93%
Total	100%

4.7 Environment and Health during Manufacturing

Manufacturing of SPF formulations and upstream chemicals is performed in industrial manufacturing facilities. Like many manufacturing processes, hazardous chemicals and manufacturing procedures may be employed. This manufacturers follow all local, state and federal regulations regarding safe use and disposal of all chemicals (United States EPA, 2024), as well as safety requirements required of the generally manufacturing operation of equipment and processes (U.S. and State OSHA-Occupational Safety and Health Standards),Safety and Health Regulations for Construction (US Department of Labor, 2024) and safe transport of all materials (US Department of Transportation-DOT) Environment and Health During Installation (US Code of Federal Regulations, November, 2024).

4.8 Packaging

ENERTITE materials are SPF chemicals that are packaged in unpressurized containers of varying types, most commonly in 55-gallon (208 L) steel or plastic drums and in some cases, plastic totes. In this study, it is assumed that the empty chemical containers are properly cleaned and taken to a drum or tote recycler. The mass % composition of packaging for both side A and side B components is shown below in Table 6. A total of 0.33 kg of packaging was used per functional unit of the spray foam product.

TABLE 6 PACKAGING COMPOSITION (MASS %)

Components	Packaging Material	Composition (%)
Side-A	Steel drum	96.5%
	Steel strap	3.5%
Side-B	Steel drum	100.0%

Disposal of packaging materials is modeled in accordance with the assumptions outlined in Part A of the PCR for Building related Products (UL Solutions, 2022). Plastic based packaging is disposed in landfill (68%), incineration (17%), and recycled (15%). Metal based packaging is disposed of in landfill (34%), incineration (9%), and recycled (57%).

4.9 Transportation

Final products are distributed via container truck, which is fueled by diesel. These final products are either sent directly to customers, or first to warehouse, prior to being sent to customers. Table 7 details distribution assumptions for the finished SPF product.

4.10 Product Processing/Installation

High-pressure SPF such as ENERTITE, is installed by professional applicators by on-site mixing of the side-A and side-B chemicals. The schematic in Figure 2 shows the typical equipment components used to produce high-pressure SPF foam, including unpressurized side-A and side-B liquid drums with transfer pumps, which are connected to the proportioner system for heating and pressurizing the chemicals, and then through a heated hose connected to a spray gun for application.

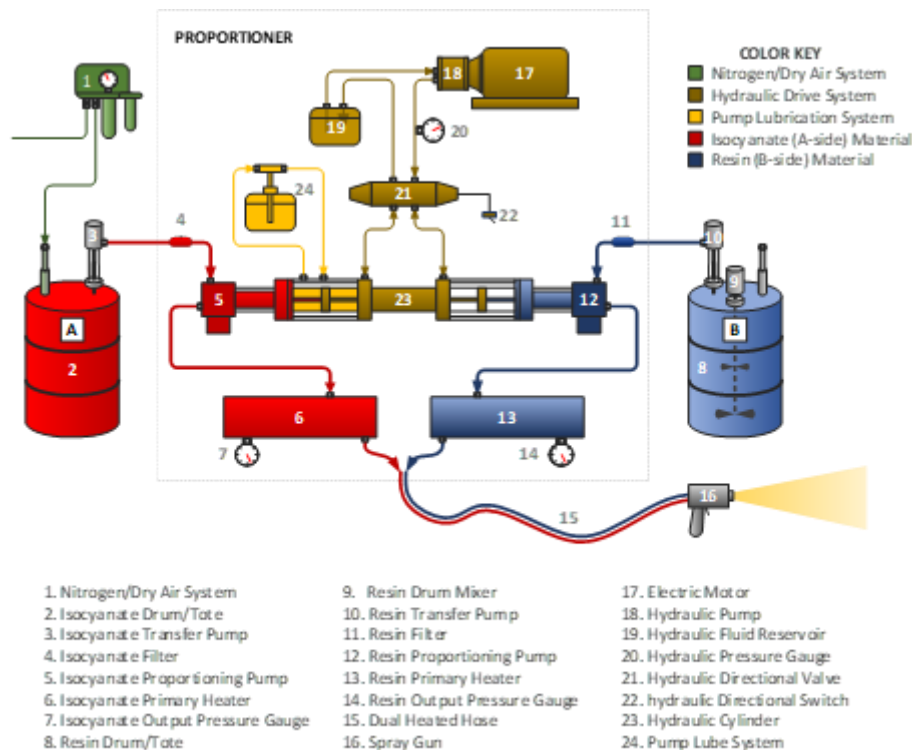


FIGURE 2 SCHEMATIC OF A HIGH-PRESSURE SPF SYSTEM

Installation includes insulation of the walls, floors and ceilings of entire buildings, or application as an insulated low-slope roofing system. These chemicals are delivered to the jobsite in unpressurized containers (usually 55-gallon / 208 L drums) and heated to approximately 120 to 130 °F (49 to 54 °C) and pressurized to about 1000 psi (6,895 kPa) by specialized equipment. The chemicals are transferred by a heated hose and aerosolized by a spray gun and combined by impingement mixing at the point of application. Personal protective equipment such as goggles, protective suits, and respirator cartridges is required to protect applicators from chemical exposure during installation. Also needed are disposable materials such as masking tape and drop cloths.

After the foam cures and expands, any excess that may prevent installation of the interior cladding is cut off and discarded. Disposal of packaging materials is modeled in accordance with the assumptions outlined in Part A of the PCR for Building related Products (UL Solutions, 2022). All ancillary installation materials are assumed to be sent to landfill.

Installation of SPF involves potential exposure to certain hazardous chemicals that requires risk mitigation through the use of personal protective equipment and on-site actions including ventilation and restricted access. Of greatest concern is the potential exposure to airborne and liquid isocyanates during and immediately after installation of SPF. Isocyanates are known chemical sensitizers and exposure can occur through contact with the skin, eyes and respiratory system. Ventilation of the work zone, coupled with use of proper personal protective equipment is required during and immediately after installation SPF. For more information on health and safety during and immediately after SPF installation, please visit www.spraypolyurethane.org.

4.11 Condition of Use

As this study only looks at the life cycle of spray foam insulation, and not the building, the use phase does not contain the emissions of any chemicals off-gassed from the foam, as the blowing agent is water. Since the blowing agent is water, this results to no impact reported in its use phase (module B1).

4.12 Environment and Health during Use

The use of any insulation in a building will provide substantial energy savings compared to not using insulation. Based on a third-party use phase analysis performed in 2018, the energy savings from SPF will eventually offset the embodied energy of SPF within a few decades, depending on climate zone and amount of insulation installed (Sustainable Solutions Corporation, 2020).

4.13 Reference Service Life

The reference service life (RSL) and estimated building service life (ESL) for SPF, when installed and used as directed is the life of the building which is 75 years.

4.14 Extraordinary Effects

Sound

Although foam will assist with noise reduction in building assemblies, there are no specific requirements for noise reduction for insulation in the building codes. Some manufacturers have measured and published noise reduction in terms of Sound Transmission Class (STC) rating per ASTM E90, and Noise Reduction Coefficient (NRC) for sound absorption per ASTM C423. These measurements are highly dependent on the assembly in which the foam is applied, and the sound frequencies used for testing.

Fire

Spray polyurethane foam, like all foam plastics and many construction materials – including wood - is a combustible material and will emit toxic gases including carbon monoxide during a fire. When used in buildings and other construction applications, foam plastics employ flame retardants to control ignition and spread of fire and development of smoke. In addition, foam plastics may need to be protected with fire-resistant coverings or coatings when used in certain construction applications, as dictated by the building codes. All foam plastic materials and assemblies should meet the fire test requirements of the applicable building codes.

Mechanical Destruction

Should the assembly the SPF is installed in, i.e. the wall or roof, have to be replaced then the SPF will have to be replaced as well.

4.15 Re-use Phase

SPF is typically not reused or recycled following its removal from a building. Thus, reuse, recycling, and energy recovery are not applicable for this product.

4.16 Disposal

When the building is decommissioned, it is assumed that only manual labor is involved to remove the foam. Waste is assumed to be transported 20 miles (32 km) to the disposal site. The spray foam is assumed to be landfilled at end-of-life, as is typical for construction and demolition waste in the US. It is further assumed the spray foam is inert in the landfill (Kjeldsen & Jensen, 2001).

4.17 Further Information

Additional information can be found at <https://spf.basf.com/>

5.0 LCA Information

5.1 Functional Unit

The product's function is to provide thermal insulation to buildings. Accordingly, the functional unit for the study is 1 m² of installed insulation material with a thickness that gives an average thermal resistance of $R_{SI} = 1 \text{ m}^2 \cdot \text{K/W}$ ($R = 5.68 \text{ hr} \cdot \text{ft}^2 \cdot ^\circ\text{F/Btu}$) with a building service life of 75 years (packaging included). The reference flow listed in the table below accounts for installation scrap waste.

TABLE 7 FUNCTIONAL UNIT PROPERTIES

Item	Value	Unit
Functional unit	1 m² of installed insulation material with a thickness that gives an average thermal resistance of $R_{SI} = 1 \text{ m}^2 \cdot \text{K/W}$	
R-value	3.73	(h·ft ² ·°F/Btu)/in
Equivalent Mass	0.66*	lb
	0.28	kg
Reference Flow	0.73*	lb
	0.33	kg
Equivalent Thickness	1.5	In
	0.038*	m

*0.038, 0.66, and 0.73 are rounded values calculated based on the conversion factors in Table 2 of the Part B PCR, which may lead to minor discrepancies

5.2 System Boundary

The study uses a cradle-to-grave system boundary. As such, it includes upstream processing and production of raw materials (A1), auxiliary material and energy resources needed for the production of SPF (A3), transport of materials (all chemical inputs for production and packaging) to SPF formulation sites (A2), transport of the components to the installation site (A4), installation of insulation (A5), removal and transport of excess insulation loss during installation to disposal site (A5), use phase (B1), transportation to end-of-life (C2), and end-of-life-disposal (C4). Over the RSL no maintenance (B2), repair (B3), replacement (B4), refurbishment (B5), operational energy (B6) or water (B7) use are required. Building energy savings from the use of insulation are excluded from this analysis. Module D has been excluded from this analysis. There are also no biogenic removals or emissions associated with the product across the assessed system boundaries.

5.3 Estimates & Assumptions

The material and energy inputs and outputs were modeled according to data provided by the production facilities, while the electricity grid and natural gas mix were chosen based on the location of each facility. Further granularity of raw material and waste data for additional locations may alter the results of this study.

When possible, energy consumption data on side-B production were collected via sub-metering. However, when not feasible, energy consumption was allocated to the spray polyurethane foam production by mass.

5.4 Cut Off Rules

The cut-off criteria for including or excluding materials, energy and emissions data of the study are as follows:

- **Mass** – According to ISO guidelines, if a flow is less than 1% of the cumulative mass of the model it may be excluded, providing its environmental relevance is not a concern. For the purpose of this LCA, all known mass flows are reported, and no known flows were deliberately excluded.
- **Energy** – According to ISO guidelines, if a flow is less than 1% of the cumulative energy of the model it may be excluded, providing its environmental relevance is not a concern. For the purpose of this LCA, all known energy flows are reported, and no known flows were deliberately excluded.
- **Environmental relevance** – If a flow meets the above criteria for exclusion yet is thought to potentially have a significant environmental impact, it was included. Material flows which leave the system (emissions) and whose environmental impact is greater than 1% of the whole impact of an impact category that has been considered in the assessment must be covered. This judgment was made based on experience and documented as necessary.

Packaging of incoming raw materials (e.g. pallets, totes, super-sacks) are excluded as they represent less than 1% of the product mass and are not environmentally relevant.

Capital goods and infrastructure flows were excluded from this analysis due to the minimal extent that it is expected to affect the LCIA results. For the manufacturing of SPF products, capital goods and infrastructure last for 20 to 40 years with periodic re-placement of valves and repair of control systems, with annual production of around 45.5 million lbs of side-B product that are included in this study. During the final stage of manufacturing (Installation) performed by SPF contractors, the life of the most expensive piece of equipment, the proportioner, is around 20 to 25 years. Diesel generators, compressors and spray guns may be around 15 to 20 years.

No known flows are deliberately excluded from this EPD.

5.5 Data Sources

The LCA model was created using the LCA for Experts (LCA FE) v10.9 software system for life cycle engineering, developed by Sphera (Sphera, 2024). Background life cycle inventory data for raw materials and processes were obtained from the Sphera MLC 2024.2 database (CUP 2024.2), except the background dataset for the isocyanate ELASTOSPRAY 8000A, which is not a part of the MLC database but was developed by BASF using MLC DB 2023.2, and shared with Sphera to be used for the purpose of this LCA study. Primary manufacturing data on production (A1-A3) of spray foam products was provided by BASF. Proxy datasets were used where no exact dataset match was found.

5.6 Data Quality

A variety of tests and checks were performed by the LCA practitioner throughout the project to ensure high quality of the completed LCA. Checks included an extensive internal review of the project-specific LCA models developed as well as the background data used. A full data quality assessment is documented in the background report.

Temporal coverage

The data are intended to represent spray polyurethane foam production during the 2023 calendar year. As such, BASF provided primary data for 12 consecutive months during the 2023 calendar year.

Geographical coverage

This LCA represents BASF's products produced in the U.S. Primary data are representative of U.S. Regionally specific datasets 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.

Technological coverage

Data on material composition, manufacturing data, waste, emissions, and energy use were collected directly from BASF.

5.7 Period Under Review

Primary data collected represent production during the 2023 calendar year. This analysis is intended to represent production in 2023.

5.8 Allocation

Multi-output allocation follows the requirements of ISO 14044, section 4.3.4.2 (ISO, 2006a; ISO, 2006b). When allocation becomes necessary during the data collection phase, the allocation rule most suitable for the respective process step was applied. Energy output was allocated based on engineering knowledge that certain products require more energy to produce. Waste outputs were allocated by mass.

The ELASTOSPRAY 8000A isocyanate dataset created by BASF is based on a “mass + elemental” allocation approach instead of purely mass allocation. This is done to make sure that the isocyanate dataset used in this study is in alignment with the MDI dataset being used in the SPFA industry association EPD, which was developed by ISOPA (European trade association for producers of diisocyanates and polyols-ISOPA, 2021) and follows the same mass + elemental allocation approach. This is also in alignment with the 2022 LCA study conducted by the ACC-American Chemistry Council. (American Chemistry Council, 2022)

The cut-off allocation approach is adopted in the case of any post-consumer and post-industrial recycled content, which is assumed to enter the system free of burdens from virgin production. Only environmental impacts from the point of recovery and forward (e.g., inbound transport, grinding, processing, etc.) are considered. Additionally, no burdens or credits are applied at end-of-life for recovered materials.

6.0 Scenarios and additional technical information

Transport to the building site uses a weighted average of the various vehicle types used by BASF’s different facilities. Table 7 is a summary of the different vehicle types and total transport distance. Liters of fuel and capacity utilization will vary depending on the vehicle type.

The following tables report results per functional unit.

TABLE 8 TRANSPORT TO THE BUILDING SITE (A4) PER FU

Name	Value	Unit
Fuel type	Diesel	
Liters of fuel	7.09E-04	l/100 km
Vehicle type	Truck, TL/Dry van	
Transport distance	1336	km
Capacity utilization (including empty runs, mass based)	75	%
Gross density of products transported	7.7	kg/m ³

TABLE 8 INSTALLATION INTO THE BUILDING (A5) PER FU

Name	Value	Unit
Ancillary materials	0.009	kg
Net freshwater consumption specified by water source and fate (amount evaporated, amount disposed to sewer)	0	m ³
Other resources	N/A	kg
Electricity consumption	0.018	kWh
Other energy carriers	1.15	MJ
Product loss per functional unit	0.011	kg
Waste materials at the construction site before waste processing, generated by product installation	0.028	kg
Output materials resulting from on-site waste processing (specified by route; e.g. for recycling, energy recovery and/or disposal)	0	kg
Biogenic carbon contained in packaging	0	kg CO ₂
Direct emissions to ambient air, soil and water	0	kg
VOC content	230	µg/m ³

TABLE 9 REFERENCE SERVICE LIFE PER FU

Name	Value	Unit
Direct emissions to ambient air, soil and water	0	kg

TABLE 10 END OF LIFE (C1-C4) PER FU

Name		Value	Unit
Assumptions for scenario development (description of deconstruction, collection, recovery, disposal method and transportation)		Landfill	
Collection process (specified by type)	Collected with mixed construction waste	0.28	kg
Recovery (specified by type)	Landfill	0.28	kg
Disposal (specified by type)	Product or material for final deposition	0.28	kg
Removals of biogenic carbon (excluding packaging)		0	kg CO ₂

7.0 Environmental Performance

North American life cycle impact assessment (LCIA) results are declared using TRACI 2.1 (Bare, 2012; EPA, 2012) methodology, with the exception of GWP and ADP_{fossil}. GWP is reported using the IPCC AR6 (IPCC, 2023) methodology, excluding biogenic carbon and including biogenic carbon. ADP_{fossil} is reported using CML 2001, Version 4.8, Aug 2016 (CML, 2001). Primary energy from non-renewable resources (NRPre) and renewable resources (RPre) represent the lower heating value (LHV) a.k.a. net calorific value (NCV). These six impact categories are globally deemed mature enough to be included in Type III environmental declarations. Other categories are being developed and defined and LCA should continue making advances in their development. However, the EPD users shall not use additional measures for comparative purposes.

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The GWP indicators reported in this study exclude land use change impacts since manufacturing, use, and disposal of SPF products do not have a significant impact on land use, as it does not consume any agricultural products or chemicals that have a direct impact on land use.

Please note that for the sake of readability, only modules with non-zero results have been shown in the tables in the following sections.

Description of the System Boundary (X = Included in LCA; MND = Module not Declared)

PRODUCT STAGE			CONSTRUCTION PROCESS STAGE		USE STAGE							END OF LIFE STAGE				BENEFITS AND LOADS BEYOND THE SYSTEM BOUNDARIES
Raw material supply	Transport	Manufacturing	Transport from the gate to the site	Assembly	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	De-construction demolition	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	X	X	X	X	X	X	X	X	X	X	X	X	X	MND

7.1 ENERTITE OPEN-CELL SPRAY FOAM INSULATION

GWP 100 is calculated using IPCC AR6 2013 methodology. ADP_{fossil} is calculated using CML baseline v4.7 Aug. 2016. All other impact assessment results are calculated using TRACI 2.1 methodology. LCIA results are relative expressions and do not predict impacts on category endpoints, the exceeding of thresholds, safety margins or risks.

TABLE 11 NORTH AMERICAN IMPACT ASSESSMENT RESULTS

IMPACT CATEGORY	A1	A2	A3	A4	A5	B1	C2	C4
GWP 100 - Incl biogenic CO2 [kg CO2 eq]	8.87E-01	6.95E-02	5.25E-02	2.70E-02	2.28E-01	0.00E+00	4.78E-04	6.39E-03
GWP 100 - Excl biogenic CO2 [kg CO2 eq]	8.86E-01	6.95E-02	5.28E-02	2.70E-02	2.28E-01	0.00E+00	4.78E-04	6.42E-03
ODP [kg CFC-11 eq]	3.94E-09	1.74E-16	6.24E-16	6.85E-17	3.94E-10	0.00E+00	1.21E-18	3.08E-16
AP [kg SO2 eq]	9.69E-04	6.60E-04	1.15E-04	9.64E-05	7.19E-04	0.00E+00	2.04E-06	3.33E-05
EP [kg N eq]	1.29E-04	3.52E-05	5.29E-06	9.28E-06	6.43E-05	0.00E+00	1.85E-07	1.43E-06
SFP [kg O3 eq]	2.15E-02	1.31E-02	1.56E-03	2.21E-03	2.17E-02	0.00E+00	4.68E-05	5.96E-04
ADP _{fossil} [MJ, LHV]	1.94E+01	8.91E-01	5.97E-01	3.53E-01	4.01E+00	0.00E+00	6.26E-03	9.45E-02
GWP = global warming potential; ODP = ozone depletion potential; AP = acidification potential; EP = eutrophication potential; SFP = smog formation potential; ADP _{Fossil} = abiotic depletion potential for fossil resources								

TABLE 12 RESOURCE USE

PARAMETER	A1	A2	A3	A4	A5	B1	C2	C4
RPR _E [MJ, LHV]	1.02E+00	3.28E-02	3.87E-02	1.54E-02	2.27E-01	0.00E+00	2.73E-04	1.21E-02
RPR _M [MJ, LHV]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.73E-04	0.00E+00	0.00E+00	0.00E+00
RPR _T [MJ, LHV]	1.02E+00	3.28E-02	3.87E-02	1.54E-02	2.28E-01	0.00E+00	2.73E-04	1.21E-02
NRPR _E [MJ, LHV]	1.44E+01	8.98E-01	6.11E-01	3.56E-01	3.37E+00	0.00E+00	6.31E-03	9.74E-02
NRPR _M [MJ, LHV]	5.87E+00	0.00E+00	0.00E+00	0.00E+00	8.03E-01	0.00E+00	0.00E+00	0.00E+00
NRPR _T [MJ, LHV]	2.03E+01	8.98E-01	6.11E-01	3.56E-01	4.17E+00	0.00E+00	6.31E-03	9.74E-02
SM [kg]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RSF [MJ, LHV]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NRSF [MJ, LHV]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RE [MJ, LHV]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FW [m ³]	5.71E-03	1.08E-04	3.27E-03	5.20E-05	1.29E-03	0.00E+00	9.22E-07	1.26E-05

RPR_E = use of renewable primary energy excluding renewable primary energy resources used as raw materials; RPR_M = use of renewable primary energy resources as raw materials; RPR_T = total use of renewable primary energy resources; NRPR_E = use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials; NRPR_M = use of non-renewable primary energy resources used as raw materials; NRPR_T = total use of non-renewable primary energy resources; SM = use of secondary material; RSF = use of renewable secondary fuels; NRSF = use of non-renewable secondary fuels; RE = use of recovered energy; FW = use of net fresh water; - = Not Applicable

TABLE 13 OUTPUT FLOWS AND WASTE CATEGORIES

PARAMETER	A1	A2	A3	A4	A5	B1	C2	C4
HWD [kg]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NHWD [kg]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.95E-02	0.00E+00	0.00E+00	2.97E-01
HLRW [kg]	3.88E-07	2.80E-09	2.15E-09	1.09E-09	6.87E-08	0.00E+00	1.94E-11	1.16E-09
ILLRW [kg]	3.31E-04	2.36E-06	1.80E-06	9.21E-07	5.81E-05	0.00E+00	1.63E-08	1.03E-06
CRU [kg]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MR [kg]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MER [kg]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.89E-03	0.00E+00	0.00E+00	0.00E+00
EE [MJ, LHV]	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

HWD = hazardous waste disposed; NHWD = non-hazardous waste disposed; HLRW = high level radioactive waste; ILLRW = intermediate and low-level radioactive waste; CRU = components for re-use; MR = materials for recycling; MER = materials for energy recovery; EE = exported energy; - = Not Applicable

8.0 Interpretation

In all impact categories, SPF environmental performance is driven primarily by raw materials (A1), in particular the isocyanate, polyols and flame retardants due to their high mass contribution to the product. Installation tends to be the second highest driver of impact due to the use of on-site diesel generator, as well as waste foam disposal.

As some of the raw materials are transported thousands of miles, the inbound transportation module (A2) is the third largest contributor to the overall impacts. Other transportation modules representing transport to site (A4) and transport to end-of-life (C2), have negligible contribution to life cycle results.

It is also important to note the assumptions and limitations to this study. These have been identified as:

- Proxy datasets were used where no exact dataset match was found. The total amount of materials represented by proxies account for less than 5% of the total product by mass and the use of proxies is not expected to have a significant influence on the results.

Results presented in this document do not constitute comparative assertions. Comparison of the environmental performance using EPD information shall be based on the product's use and impacts at the construction works level. 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.

Manufacturing of SPF formulations and upstream chemicals is performed in industrial manufacturing facilities. Like many manufacturing processes, hazardous chemicals and manufacturing procedures may be employed. These manufacturers follow all local, state and federal regulations regarding safe use and disposal of all chemicals (United States EPA, 2024) (United States EPA, 2024), as well as safety requirements required of the generally manufacturing operation of equipment and processes (U.S. and State OSHA-Occupational Safety and Health Standards), (Safety and Health Regulations for Construction) (US Department of Labor, 2024) and safe transport of all materials (US Department of Transportation-DOT) Environment and Health During Installation (US Code of Federal Regulations, November 2024).

8.1 Environmental Activities and Certifications

BASF has certified or tested their insulation products to various VOC standards to measure emissions of volatile or semi-volatile compounds, and thus do not emit significant VOCs. These standards include:

- UL Environment GREENGUARD® Certification – The GREENGUARD® Certification Program specifies strict certification criteria for VOC's and indoor air quality. This voluntary program helps consumers identify products that have low chemical emissions for improved indoor air quality.
- California Department of Public Health (CDPH) – Also known as Section 01350, this small-chamber emissions test standard is detailed under: Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers (Standard Methods v1.1-2010 and v1.2-2017).
- Canadian ULC – Required for SPF insulation products, this standard provides a similar VOC emissions test protocol specifically for SPF: CAN/ULC S774 Standard Laboratory Guide for the Determination of Volatile Organic Compound Emissions from Polyurethane Foam.
- Currently, an ASTM workgroup is developing a small-chamber emissions test protocol for chemical compounds specific to SPF that include MDI, blowing agents, flame retardants and catalysts.

8.2 Natural Oil Polyols

Natural Oil Polyols, or NOPS, are being used in some spray foam formulations, as some manufacturers are using renewable materials in their formulation to help differentiate their products from conventional petroleum-based materials. NOPS may include vegetable oils such as soy, castor, glycerin and rapeseed. This LCA was based on conventional petroleum-based polyols, as these are the most widely used in the industry and more representative of most current spray foam formulations.

9.0 References

American Chemistry Council. (2022). *Cradle-to-gate Life Cycle Analysis of Methylene Diphenyl Diisocyanate (MDI)*.

Bare, J. (2012). *Tool for the Reduction and Assessment of Chemical and other Environmental Impacts (TRACI) - Software Name and Version Number: TRACI version 2.1 - User's Manual*. Washington, D.C.: U.S. EPA.

CML. (2001). *CML's Impact Assessment Methods and Characterisation Factors*. Leiden University, Institute of Environmental Science.

EPA. (2012). *Tool for the Reduction and Assessment of Chemical and other Environmental Impacts (TRACI) - User's Manual*. Washington, D.C.: US EPA.

European Diisocyanate and Polyol Producers Association (ISOPA). (2021). *Eco-profile of toluene diisocyanate (TDI) and methylene diphenyl diisocyanate (MDI)*.

Honeywell International. (n.d.). *Predictive Model for Polyurethane Blowing Agent Emissions into a House*. Buffalo.

IPCC. (2023). *Climate Change 2023: Synthesis Report*. Geneva, Switzerland: IPCC.

ISO. (2006). *ISO 14025: Environmental labels and declarations - Type III environmental declarations - principles*. International Organizations for Standardization.

ISO. (2006a). *ISO 14040: Environmental management – Life cycle assessment – Principles and framework*. Geneva: International Organization for Standardization.

ISO. (2006b). *ISO 14044: Environmental management – Life cycle assessment – Requirements and guidelines*. 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.

Kjeldsen, P., & Jensen, M. (2001). Release of CFC-11 from Disposal of Polyurethane Foam Waste. *ENVIRONMENTAL SCIENCE & TECHNOLOGY*, 3055-3063.

Occupational Safety and Health Standards. (n.d.). *US Code of Federal Regulations, Title 29, Subtitle B, Chapter XVII, Part 1910*. Retrieved from <https://www.ecfr.gov/current/title-29/subtitle-B/chapter-XVII/part-1910>

Safety and Health Regulations for Construction. (n.d.). *US Code of Federal Regulations, Title 29, Subtitle B, Chapter XVII, Part 1926*. Retrieved from <https://www.ecfr.gov/current/title-29/subtitle-B/chapter-XVII/part-1926>

SPFA. (2018). *Environmental Product Declaration: Spray Polyurethane Foam Insulation*. ASTM.

Sphera. (2024). *Sphera LCA Database Documentation*. Retrieved from Sphera Solutions, Inc.: <https://sphera.com/product-sustainability-gabi-data-search/>

Sustainable Solutions Corporation. (2020). *SPF Residential Energy Modeling Analysis*.

UL Solutions. (2022). *Product Category Rules for Building-Related Products and Services - Part A: Life Cycle Assessment Calculation Rules and Report Requirements, UL 10010 (v4.0)*.

UL Solutions. (2024). *PCR Part B: Building Envelope Thermal Insulation EPD Requirements UL 10010-1 (v.3.0)*.

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United States EPA. (2024, November). *US Code of Federal Regulations, Title 40*. Retrieved from <https://www.ecfr.gov/current/title-40>

United States EPA. (2024, November). *Waste, Chemical, and Cleanup Enforcement*. Retrieved from <https://www.epa.gov/enforcement/waste-chemical-and-cleanup-enforcement>

US Code of Federal Regulations. (November, 2024). *Federal Motor Carrier Safety Regulations*. Retrieved from Title 49, Subtitle B, Chapter III, Part 397: <https://www.ecfr.gov/current/title-49/subtitle-B/chapter-III/subchapter-B/part-397>

US Department of Labor. (2024, November). *Law and Regulations*. Retrieved from <https://www.osha.gov/laws-regs>

US Department of Labor. (2024, November). *State Plans*. Retrieved from <https://www.osha.gov/stateplans>