CERTIFIED
ENVIRONMENTAL PRODUCT DECLARATION
OPTIMIZATION
UL.COM/EPD

Optimization Summary
Environmental Product Declaration

Company Name Thermafiber, Inc.

Validity Period 5 Years

EPD Name, Declaration Number, Certification Period
Thermafiber® Mineral Wool,4790011847.101.2, October 1, 2021 - October 1, 2026

Reference EPD Name, Declaration Number, Certification Period
Thermafiber® Mineral Wool, 4788956323.101.1, October 1, 2019 – October 1, 2024

Product Category Rules & Version Number UL Part B: Building Envelope Thermal Insulation EPD Requirements, UL 10010-1

Reference EPD ☑ Product Specific ☐ Industry Average

Link to Optimization Addendum

Comparability Criteria Totals (from comparability worksheet) 11 1 0 0

Conforms with LEED v4 Building Product Disclosure and Optimization - EPDs, Option 2. Multi-attribute optimization
The comparison of these construction products conforms to the requirements of ISO 14025 §5.6, §6.7.2 and ISO 21930 §5.5, §7.3.

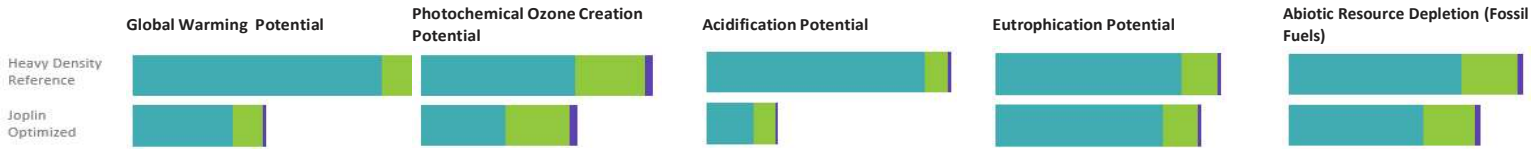
Results

Modules in Which Changes Occur

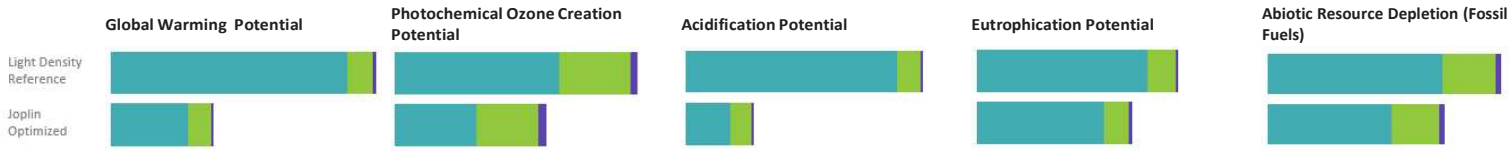
PRODUCT STAGE			CONSTRUCTION STAGE		USE STAGE							END OF LIFE STAGE			
Raw material supply	Transport	Manufacturing	Transport from gate to site	Assembly/ Installation	Use	Maintenance	Repair	Replacement	Refurbishment	Operational Energy Use	Operational Water Use	Deconstruction/ demolition	Transport	Waste processing	Disposal
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4
✔	✔	✔	✔	✔									✔		✔

Environmental Impact Reduction

Percent change is not an appropriate method to represent changes in Ozone Depletion Potential, due to large differences in orders of magnitude between results.



	Global Warming Potential		Photochemical Ozone Creation Potential		Acidification Potential		Eutrophication Potential		Abiotic Resource Depletion (Fossil Fuels)	
	Reference	Joplin Optimized	Reference	Joplin Optimized	Reference	Joplin Optimized	Reference	Joplin Optimized	Reference	Joplin Optimized
PRODUCT	6.6	2.6	3.4E-01	1.8E-01	4.9E-02	1.0E-02	2.9E-03	2.6E-03	6	4
CONSTRUCTION	0.9	0.8	1.5E-01	1.4E-01	5.3E-03	4.9E-03	5.5E-04	5.2E-04	1.8	1.7
USE	0.0	0.0	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0	0.0
END OF LIFE	0.1	0.1	1.7E-02	1.6E-02	5.7E-04	5.5E-04	5.8E-05	5.6E-05	0.2	0.2
		-53%		-33%		-71%		-9%		-18%



	Global Warming Potential		Photochemical Ozone Creation Potential		Acidification Potential		Eutrophication Potential		Abiotic Resource Depletion (Fossil Fuels)	
	Reference	Joplin Optimized	Reference	Joplin Optimized	Reference	Joplin Optimized	Reference	Joplin Optimized	Reference	Joplin Optimized
PRODUCT	3.8	1.2	1.7E-01	8.6E-02	2.3E-02	4.9E-03	1.6E-03	1.2E-03	3	2
CONSTRUCTION	0.4	0.4	7.5E-02	6.7E-02	2.6E-03	2.3E-03	2.7E-04	2.4E-04	0.9	0.8
USE	0.0	0.0	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0	0.0
END OF LIFE	0.0	0.0	8.0E-03	7.5E-03	2.8E-04	2.6E-04	2.8E-05	2.6E-05	0.1	0.1
		-61%		-38%		-71%		-23%		-24%

Optimization Sources

Improvements in the environmental footprint of product produced in Joplin can be attributed to increased plant operating efficiency and improved cupola and manufacturing line operational stability. The earlier LCA study included some data that was collected within 12 months of the initial plant start up when much process fine tuning was still underway. By increasing the amount of saleable product from a similar of amount of raw materials, the overall impacts per functional unit decreased. Increases were achieved through density efficiency work and better consistency of the manufacturing line. Improved operational stability of the cupola also led to significant improvements in air emissions.

Interpretation

Using the comparability criteria, the comparison can be termed a robust comparison. All of the criteria were identical or equivalent. Both EPDs are product specific, cover the same system boundaries, use the same LCI background data, software, impact assessment method, PCR, and employ the same assumptions and calculations for use phase, end of life, allocation, cut-off rules and equivalent provision of additional environmental information. Due to a change from grouping results in light and heavy density products at the network level to reporting results in terms of a reference product at the facility level with scaling factors to convert to other products, the scope for the comparison is equivalent, rather than identical. These results cover the same products listed in the EPD: Fire & Sound Guard® Plus, FireSpan® 40, 90 & 120, Safing (4 pcf | 64 kg/m^3) & (6 pcf | 96 kg/m^3), SAFB™ (2.5 pcf | 40 kg/m^3) & (4 pcf | 64 kg/m^3), RainBarrier®, RainBarrier® Dark®, RainBarrier® ci High Compressive (80), RainBarrier® ci High Compressive Plus (110), RainBarrier® ci High Compressive Max (140), and VersaBoard® 35, 40, 60 & 80.

Comparability Criteria
Environmental Product Declaration

UL Environment Comparability Rating Results
Select as applicable; totals displayed on Summary front

Representativeness	
Scope	
System Boundaries	
LCI Background Data & LCA software	
Data Quality	
Impact Assessment	
Use Phase Calculations	
End of Life Assumptions	
Allocation Rules	
Cut-Off Rules	
Materials & Additional Information	
EPD Content & PCR Version	
Comparability Criteria Totals	11 · 1 · 0 · 0

Interpretation

Robust Comparison

- ≥7 More than half of criteria are equivalent or identical for comparison
- ≤5 Less than half of criteria require additional interpretation for comparison
- 0 No criteria are flagged that warrant significant justification for comparison
- 0 No criteria are flagged that prevent comparison

Compare with Caution

- ≤5 Less than half of criteria are equivalent or identical for comparison
- ≥7 More than half of criteria require additional interpretation for comparison
- ≤1 One or no criteria are flagged that warrant significant justification for comparison
- 0 No criteria are flagged that prevent comparison

Ineligible for Comparison

- >1 More than one criteria are flagged that warrant significant justification for comparison
- ≥1 One or more criteria are flagged that prevent comparison

Results and interpretation are further explained in the Optimization Addendum provided at: Addendum Attached

Comparability Criteria

Representativeness
- If benchmark EPD is industry average, the compared product specific EPD is represented in the average
- If benchmark EPD is product specific, the compared product is equivalent
- Product specific EPD is not represented in industry average EPD or not equivalent to benchmark

Scope
- Identical functional units, product category definition/description and equivalent period of validity
- Equivalent functional units, product category definition/description, and period of validity
- Different functional units, product category definition/description, and/or different period of validity

System Boundaries
- Equivalent system boundaries with equivalent modules excluded
- Includes A1-A3 with identical use phase and EOL options Includes
- A1 - A3, no use phase, no EOL options

LCI Background Data & Software
- Consistent LCI background data and software
- Consistent LCI background data, different software
- Consistent software, different LCI background data
- Different LCI background data, different software

Data Quality*
- Equivalent data quality with equivalent data collection procedures
- Some equivalent data quality and data collection procedures
- Different data quality with different data collection procedures

*Quality refers to coverage, precision, completeness, representativeness, consistency, reproducibility, and sources

Impact Assessment Method
- Identical inventory and impact assessment categories, method & version
- Equivalent inventory and impact assessment categories, method & version
- Different inventory and impact assessment categories, method & version

Assumptions & Calculations

Use phase
- Identical use phase calculations and units
- Different use phase calculations and units

End of Life
- Equivalent end of life assumptions by disposal option
- Different end of life assumptions by disposal option

Allocation
- Equivalent choice of allocation method(s)
- Different choice of allocation method(s) with robust sensitivity analysis showing allocation choice affects results by <5%
- Different choice of allocation method(s) w/o sensitivity analysis

Cut-off Rules
- Identical application of cut-off criteria for inclusion of flows
- Different application of cut-off criteria with robust sensitivity analysis showing cut-off criteria affects results by <5%
- Different application of cut-off criteria without sensitivity analysis

Materials & Additional Information
- Equivalent provision of additional environmental information, declared materials and substances
- Different additional environmental information, declared materials and substances

EPD Content and PCR Version
- Equivalent EPD content, format, and reference PCR version number
- Different EPD content, format, and reference PCR version number

Optimization Addendum

ENVIRONMENTAL PRODUCT DECLARATION

Thermafiber® Mineral Wool

According to ISO 14025 and ISO 21930

MANUFACTURER NAME AND ADDRESS	**THERMAFIBER, INC., ONE OWENS CORNING PARKWAY, TOLEDO, OH, USA**
OPTIMIZATION SUMMARY LINK	Optimization Summary attached, page 1
OPTIMIZED EPD NAME, DECLARATION NUMBER, CERTIFICATION PERIOD	Thermafiber® Mineral Wool, 4790011847.101.2
OPTIMIZED EPD LINK	Thermafiber® Mineral Wool
REFERENCE EPD NAME, DECLARATION NUMBER, CERTIFICATION PERIOD	Thermafiber® Mineral Wool, 4788956323.101.1, October 1, 2019 – October 1, 2024
REFERENCE EPD LINK	Included in Appendix - Reference EPD
REFERENCE EPD	☒ Product specific ☐ Industry average
PRODUCT CATEGORY RULES AND VERSION	UL Part B: Building Envelope Thermal Insulation EPD Requirements, UL 10010-1
THIS OPTIMIZIATION WAS INDEPENDENTLY VERIFIED BY:	Thomas P. Gloria, Industrial Ecology Consultants
DATE OF ISSUE	10/1/2021
PERIOD OF VALIDITY	5 Years

The comparison of these construction products conforms to the requirements of ISO 14025 §5.6, §6.7.2 and ISO 21930 §5.5, §7.3.

LIMITATIONS

Full conformance with a PCR 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.

1. Introduction

In our continuing effort to reduce the environmental footprint of our products and operations, we have chosen to evaluate our Thermafiber® Mineral Wool Insulation product produced in 2020 shown in the current, optimized EPD against the product which was produced in 2018 shown in the earlier reference EPD for the product. Improvements in the environmental footprint of product produced in Joplin can be attributed to increased plant operating efficiency and improved cupola and manufacturing line operational stability. The earlier LCA study included some data that was collected within 12 months of the initial plant start up when much process fine tuning was still underway. By increasing the amount of saleable product from a similar of amount of raw materials, the overall impacts per functional unit decreased. Increases were achieved through density efficiency work and better consistency of the manufacturing line. Improved operational stability of the cupola also led to significant improvements in air emissions.

2. Comparability Criteria

1.1. Representativeness

In order to allow for greater transparency at the product level, the results in the optimized EPD are reported in terms of a reference product with scaling factors to convert results to other products for each manufacturing location. The reference EPD grouped products into light and heavy density products as a production weighted average of all manufacturing facilities. The underlying products included in both LCA studies were the same, only the format for reporting results was changed. In order to make the comparison equivalent, optimized reference product results were scaled to the 2020 products whose density most closely matched the densities of the 2018 light and heavy density groups. For light density products, the comparison was made to Fire and Sound Guard® Plus R-24. For heavy density products, the comparison was made to FireSpan® 90.

1.2. Scope

The functional unit for the comparison is identical, 1 m^2 of insulation at R_{SI}=1. Due to a change from grouping results in light and heavy density products to reporting results in terms of a reference product with scaling factors to convert to other products, the scope for the comparison is equivalent, rather than identical. The original EPD is valid through October 1, 2024, while the optimized EPD is valid through October 1, 2026. Although not identical, the validity periods overlap.

1.3. System Boundaries

Since the energy savings during the use stage of thermal insulation can vary greatly depending on the installed conditions, the modules in the use stage were not declared for either product. Stages C1 and C3 from End of Life Stage were not declared for either product since the products are both sent with mixed construction waste to the landfill.

Table 1. Description of the system boundary modules

	PRODUCT STAGE			CONSTRUCT-ION PROCESS STAGE		USE STAGE							END OF LIFE STAGE				BENEFITS AND LOADS BEYOND THE SYSTEM BOUNDARY
	A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
	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
Optimized Product	☒	☒	☒	☒	☒	☐	☐	☐	☐	☐	☐	☐	☐	☒	☐	☒	☐
Reference Product	☒	☒	☒	☒	☒	☐	☐	☐	☐	☐	☐	☐	☐	☒	☐	☒	☐

1.4. LCI Background Data and Software

In order to have a robust comparison, the LCA model used in the reference EPD was updated to use the same data set (ecoinvent 3.6) which was used to create the LCA model for the optimized EPD. Due to increased transparency into the supply chain and enhanced modeling efforts, the 2018 data was updated as needed to match 2020 modeling choices around oxygen, slag and binder. The materials and manufacturing processes used in the old and new products were identical. The optimized and updated reference model were both analyzed using SimaPro 9.1.

1.5. Data Quality

Both the 2018 and 2020 sets of data were collected in a similar manner from the plants producing the product.

1.6. Impact Assessment Method

The TRACI 2.1 v1.05 impact assessment method was used to compare the model for the updated reference EPD and the optimized EPD.

1.7. Use Phase

The Use Phase was identical since it was not declared for either product.

1.8. End of Life

The End of Life for both products assumes the products are sent to landfill since no programs currently exist for the recycling or reuse of mineral wool insulation.

1.9. Allocation

The same allocation method, by product mass, was used by both analyses when it was not possible to attribute individual process inputs and outputs to individual product outputs.

1.10. Cut-off Rules

The cut-off criteria for inclusion of flows were identical for both products.

1.11. Materials and Additional Information

The optimized EPD has additional information regarding energy savings during the use phase which had not developed at the time of the reference EPD.

1.12. EPD Content and PCR Version

The same PCR version was used for both EPDs. There are no differences in content or format.

3. Life Cycle Impact Assessment Results

Optimized values in the tables below have been scaled to the appropriate product for comparison. To enable the light density product comparison, results of the reference product found in the EPD were multiplied by 1.42. To enable the heavy density product comparison, results of the reference product found in the EPD were multiplied by 3.02.

Table 2. TRACI Optimized EPD Impact Assessment Results – Joplin – FireSpan® 90 (Heavy Density)

TRACI v2.1	A1-A3	A4	A5	B1-B7	C1	C2	C3	C4
GWP 100 [kg CO2 eq]	2.65E+00	7.94E-01	9.85E-03	MND	MND	7.61E-02	MND	8.37E-03
ODP [kg CFC-11 eq]	3.63E-07	1.92E-07	4.76E-10	MND	MND	1.84E-08	MND	1.88E-09
AP [kg SO_2 eq]	1.05E-02	4.94E-03	1.62E-05	MND	MND	4.73E-04	MND	8.07E-05
EP [kg N eq]	2.59E-03	5.16E-04	3.55E-06	MND	MND	4.94E-05	MND	6.99E-06
POCP [kg O_3 eq]	1.85E-01	1.44E-01	4.26E-04	MND	MND	1.37E-02	MND	2.44E-03
ADP_{fossil} [MJ, LHV]	4.43E+00	1.70E+00	4.22E-03	MND	MND	1.63E-01	MND	1.68E-02

[GWP 100 - Global Warming Potential]; [ODP - Ozone Depletion Potential]; [AP - Acidification Potential]; [EP - Eutrophication Potential]; [POCP - Smog Formation Potential]; [ADPfossil - Abiotic Resource Depletion Potential of Non-renewable (fossil) energy resources]

Table 3. TRACI Optimized EPD Impact Assessment Results – Joplin – Fire and Sound Guard® Plus R-24 (Light Density)

TRACI v2.1	A1-A3	A4	A5	B1-B7	C1	C2	C3	C4
GWP 100 [kg CO2 eq]	1.25E+00	3.73E-01	4.63E-03	MND	MND	3.58E-02	MND	3.94E-03
ODP [kg CFC-11 eq]	1.70E-07	9.03E-08	2.24E-10	MND	MND	8.65E-09	MND	8.85E-10
AP [kg SO_2 eq]	4.92E-03	2.32E-03	7.60E-06	MND	MND	2.22E-04	MND	3.80E-05
EP [kg N eq]	1.22E-03	2.43E-04	1.67E-06	MND	MND	2.32E-05	MND	3.29E-06
POCP [kg O_3 eq]	8.70E-02	6.75E-02	2.00E-04	MND	MND	6.46E-03	MND	1.15E-03
ADP_{fossil} [MJ, LHV]	2.08E+00	8.00E-01	1.98E-03	MND	MND	7.66E-02	MND	7.88E-03

Table 4. TRACI Reference EPD Impact Assessment Results – Heavy Density (Updated)

TRACI v2.1	A1-A3	A4	A5	B1-B7	C1	C2	C3	C4
GWP 100 [kg CO2 eq]	6.59E+00	8.51E-01	1.10E-03	MND	MND	7.84E-02	MND	8.62E-02
ODP [kg CFC-11 eq]	4.84E-07	2.06E-07	4.38E-11	MND	MND	1.90E-08	MND	1.94E-08
AP [kg SO_2 eq]	4.86E-03	5.29E-03	1.55E-06	MND	MND	4.87E-04	MND	8.32E-05
EP [kg N eq]	2.85E-03	5.53E-04	1.73E-07	MND	MND	5.09E-05	MND	7.20E-06
POCP [kg O_3 eq]	3.39E-01	1.54E-01	4.43E-05	MND	MND	1.42E-02	MND	2.51E-03
ADP_{fossil} [MJ, LHV]	5.66E+00	1.82E+00	3.90E-04	MND	MND	1.68E-01	MND	1.73E-02

Table 5. TRACI Reference EPD Impact Assessment Results – Light Density (Updated)

TRACI v2.1	A1-A3	A4	A5	B1-B7	C1	C2	C3	C4
GWP 100 [kg CO2 eq]	3.78E+00	4.15E-01	2.95E-03	MND	MND	3.78E-02	MND	4.16E-03
ODP [kg CFC-11 eq]	2.35E-07	1.00E-07	1.18E-10	MND	MND	9.14E-09	MND	9.35E-10
AP [kg SO_2 eq]	2.30E-02	2.58E-03	4.16E-06	MND	MND	2.35E-04	MND	4.01E-05
EP [kg N eq]	1.61E-03	2.69E-04	4.64E-07	MND	MND	2.46E-05	MND	3.47E-06
POCP [kg O_3 eq]	1.75E-01	7.49E-02	1.19E-04	MND	MND	6.83E-03	MND	1.21E-03
ADP_{fossil} [MJ, LHV]	2.89E+00	8.88E-01	1.05E-03	MND	MND	8.09E-02	MND	8.32E-03

Table 6. TRACI Reference EPD Impact Assessment Results – Heavy Density

TRACI v2.1	A1-A3	A4	A5	B1-B7	C1	C2	C3	C4
GWP 100 [kg CO2 eq]	9.71E+00	1.00E+00	1.15E-03	MND	MND	9.22E-02	MND	1.83E-02
ODP [kg CFC-11 eq]	1.14E-06	2.47E-07	6.19E-11	MND	MND	2.28E-08	MND	8.85E-09
AP [kg SO_2 eq]	6.95E-02	6.23E-03	1.86E-06	MND	MND	5.74E-04	MND	1.60E-04
EP [kg N eq]	2.61E-02	1.24E-03	5.09E-05	MND	MND	1.15E-04	MND	3.42E-05
POCP [kg O_3 eq]	7.65E-01	1.69E-01	4.92E-05	MND	MND	1.56E-02	MND	3.81E-03
ADP_{fossil} [MJ, LHV]	1.17E+01	2.22E+00	5.62E-04	MND	MND	2.05E-01	MND	8.22E-02

Table 7. TRACI Reference EPD Impact Assessment Results – Light Density

TRACI v2.1	A1-A3	A4	A5	B1-B7	C1	C2	C3	C4
GWP 100 [kg CO2 eq]	4.77E+00	4.88E-01	3.07E-03	MND	MND	4.45E-02	MND	8.84E-03
ODP [kg CFC-11 eq]	4.28E-07	1.20E-07	1.66E-10	MND	MND	1.10E-08	MND	4.27E-09
AP [kg SO_2 eq]	2.99E-02	3.04E-03	4.99E-06	MND	MND	2.77E-04	MND	7.74E-05
EP [kg N eq]	1.29E-02	6.06E-04	1.36E-04	MND	MND	5.52E-05	MND	1.65E-05
POCP [kg O_3 eq]	2.92E-01	8.23E-02	1.32E-04	MND	MND	7.51E-03	MND	1.84E-03
ADP_{fossil} [MJ, LHV]	4.67E+00	1.08E+00	1.51E-03	MND	MND	9.88E-02	MND	3.97E-02

4. Interpretation of Optimization Results

Since much of the reduction seen can be attributed to operational and density efficiencies, decreases are seen across the stages with the greatest improvements in stages A1-A3. Reduced mass per functional unit also contributes to reductions in A4, A5, C2 and C4. A slight decrease in average transport distance reduces A4.

Using the comparability criteria, the comparison can be termed a robust comparison. All of the criteria were identical or equivalent. Both EPDs are product specific, cover the same system boundaries, use the same LCI background data, software, impact assessment method, PCR, and employ the same assumptions and calculations for use phase, end of life, allocation, cut-off rules and equivalent provision of additional environmental information. Due to a change from grouping results in light and heavy density products to reporting results in terms of a reference product with scaling factors to convert to other products, the scope for the comparison is equivalent, rather than identical. These results cover the same products listed in the EPD: Fire & Sound Guard® Plus, FireSpan® 40, 90 & 120, Safing (4 pcf | 64 kg/m^3) & (6 pcf | 96 kg/m^3), SAFB™ (2.5 pcf | 40 kg/m^3) & (4 pcf | 64 kg/m^3), RainBarrier®, RainBarrier® Dark, RainBarrier® ci High Compressive (80), RainBarrier® ci High Compressive Plus (110), RainBarrier® ci High Compressive Max (140), and VersaBoard® 35, 40, 60 & 80.

1. Appendix - Reference EPD

101.1_Owens-Corning_EPD_Thermafiber

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