



Environmental Product Declaration

# Arriscraft Calcium Silicate Cladding



**Product Name:** Calcium Silicate Cladding

**Product Group:** Cladding System Products

**EPD Scope:** Cradle-to-Gate

**Declaration Holder:** Arriscraft

**Program Operator:** ASTM International

**Declaration Number:** EPD-055

**Date of Issuance:** December 8, 2016

**End of Validity:** December 8, 2021

**Reference PCR:** Underwriters Laboratory Product Category Rule (PCR) for Preparing an Environmental Product Declaration (EPD) for Product Group Cladding System Products; Version (June 18, 2015)

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**Third Party Review:** Independent verification of the declaration and data, according to ISO 14025:2006 and ISO 21930:2007

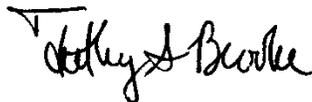
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*Explanatory information about the EPD content can be obtained at (<http://www.ul.com/global/eng/pages/offerings/businesses/environment/services/certification/epd/index.jsp>) or send an email to [epd@ul.com](mailto:epd@ul.com)*

## Product Description

The declared unit is 100 Square Feet of Calcium Silicate Cladding – as Manufactured at Arriscraft's Cambridge Ontario facility. The product system is the A1-A3 Cradle-to-Gate production of the cladding system.

The calcium silicate cladding product system is an average product (i.e. the product profile represents the weighted average of Arriscraft's calcium silicate cladding product offerings) produced at the manufacturer's specific plant.

The product system includes the ancillary materials that are included in the installation of the product, mortar and masonry connectors. Arriscraft produces only the calcium silicate brick component of the cladding system. The installer purchases the mortar and masonry connectors separately.

### Application:

Required properties for calcium silicate masonry are described in ASTM C73, Standard Specification for Calcium Silicate Brick (Sand-Lime Brick). This standard classifies calcium silicate products as either moderate-weathering or severe weathering depending on the material's tested properties of compressive strength and 24-hour absorption. Arriscraft calcium silicate units meet the severe weathering requirements of this standard.

Calcium silicate is recognized as a suitable material for masonry construction in Canada under both CSA A371, Masonry Construction for Buildings (ref. 5.1.3) and the National Building Code of Canada (ref. 9.20.2.1(1)(a)).

Calcium silicate is recognized as a suitable material for masonry construction in the United States under TMS 602 / ACI 530.1 / ASCE 6, Specification for Masonry Structures (ref. 2.3 A). The International Building Code (ref. 2103.1) references Specification for Masonry Structures for suitable masonry unit materials.

### Technical Information:

**Table 1: Technical Information**

Name	Value	Unit	Test Method
Compressive Strength	5500 (min)	psi	ASTM C140
Density	130 (avg)	lb/ft <sup>3</sup>	ASTM C140
Absorption	15 (max)	%	ASTM C140

**Arriscraft Calcium Silicate Cladding**

According to ISO 14025 and ISO 21930

**Declaration Number:****Date of Issuance:****Market Placement/Installation Requirements:**

TMS 402 / ACI 530 / ASCE 5, Building Code Requirements for Masonry Structures governs the use of calcium silicate units in masonry construction.

**Materials:***100 Square Feet of Calcium Silicate Cladding Declared Unit Composition*

- 95.8 Square Feet of Calcium Silicate Bricks: 1,639.7 kg (3,614.9 lbs)
- 4.2 Square Feet of Mortar: 45.4 kg (100.1 lbs)
- Masonry Connectors: 5.7 kg (12.6 lbs)

**Manufacturing:**

Calcium Silicate Cladding is a manufactured masonry product. Lime and inherently strong silica-based sand are mixed and then pressed into modular sized units under very high pressure. The “green” units are then subjected to high-pressure steam in an autoclave to produce a unit with a uniformly fine-grained texture. A calcium silicate hydrate binder is formed when the elements in the raw materials chemically react in the autoclave resulting in a durable, strong and integrally bonded unit. A wide variety of distinctive colors can be produced ranging from natural white to pastel shades to earthen tones.

**Environment and Health Considerations during Manufacturing:**

Under the Ministry of the Environment and Climate Change for Ontario we have an Environmental Compliance Approval that was applied under section 20.2 of Part II.1 of the Environmental Protection Act, R.S.O. 1990, c. E. 19.

**Packaging:**

Table 2 lists the packaging inputs that are included in the shipment of calcium silicate cladding to Arriscraft’s customers. Some packaging materials (i.e.pallets) may be reused.

**Table 2: Packaging Inputs**

Input	Amount per ton bricks manufactured	Unit	Amount per 100 square feet installed	Unit
Pallets	10.21	kg	16.73	kg
Stretch Wrap	0.32	kg	0.52	kg
Bags	0.33	kg	0.53	kg
Bubblewrap	0.16	kg	0.26	kg
Styrofoam	0.38	kg	0.62	kg

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## Product Installation:

The installation of the product includes the application of mortar and masonry connectors by a skilled tradesperson. The materials used in the installation (mortar and masonry connectors) have been included in A1. Some mortar waste is generated during installation.

## Environment and Health Considerations During Use:

The calcium silicate brick product is comprised of inert materials and poses no significant environmental or health considerations during the use phase.

## Recycling, Energy Recovery, and Disposal:

At the end of the product's service life, it may be removed and re-installed or crushed and disposed in a manner similar to any other inert high-mass material (i.e. inert material landfill and/or used as fill material). No energy recovery possibilities exist.



## Life Cycle Assessment

### Declared Unit:

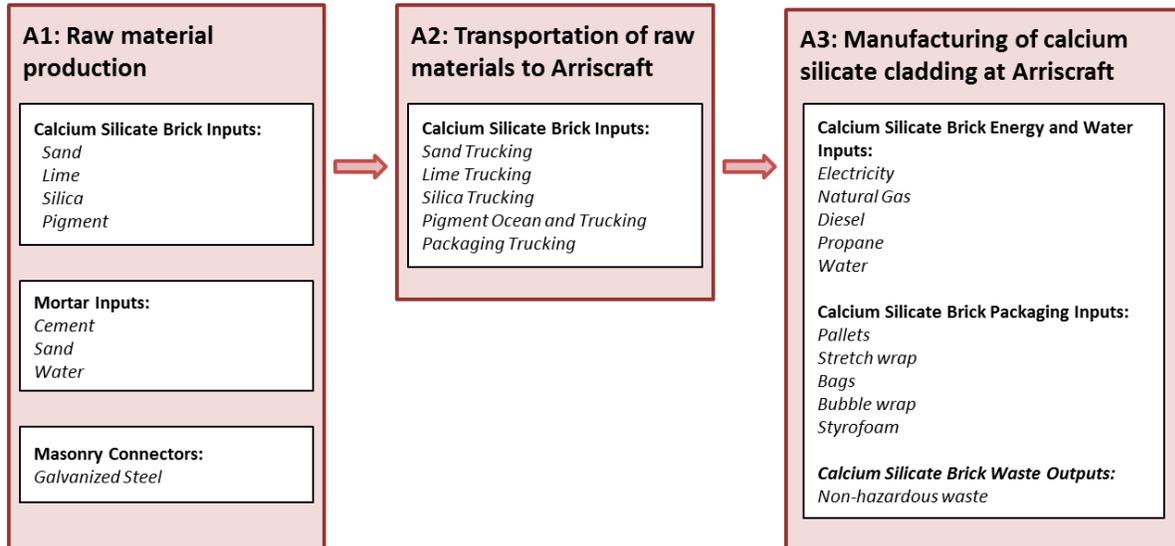
The declared unit is 100 Square Feet of Calcium Silicate Cladding – as Manufactured at Arriscraft’s Cambridge Ontario facility.

### System Boundary:

The system boundary for this study is limited to a cradle-to-gate focus. The following three life cycle stages as per the governing PCR are included in the study scope (see Figure1):

- A1- Raw material supply (upstream processes): extraction, handling, and processing of the calcium silicate raw materials as well as the intermediate component products and fuels used in the production of the cladding product.
- A2- Transportation: transportation of all input materials and fuels from the supplier to the gate of the manufacturing facility.
- A3- Manufacturing (core process): the energy used to store, move, batch and mix the calcium silicate product. Also includes the operations of the manufacturing facility as well as the transportation and processing of wastes from these core processes.

**Figure 1: Cradle-to-gate product system for calcium silicate brick cladding**



**Estimates and Assumptions:**

All significant foreground data was gathered from the manufacturer based on measured values (i.e. without estimation). The weighted average product profile is assumed to be representative of the various dimensions and finish options offered by Arriscraft for their calcium silicate brick product offerings.

**Allocation:**

As prescribed by the UL PCR, the applied allocation procedures conform with ISO14044 clause 4.3.4. At the Cambridge ON facility, all the processing required (handling, curing, etc) for the various products was allocated on a mass basis to reflect the nature of the inventory flows relative to the product outputs.

**Cut-off Criteria:**

The cut-off criteria for all activity stage flows considered within the system boundary conform with ISO14044:2006 and section 3.3 of the governing PCR. Specifically, the cut-off criteria were applied as follows:

- All inputs and outputs for which data are available are included in the calculated effects and no collected core process data are excluded.
- A one percent cut-off is considered for renewable and non-renewable primary energy consumption and the total mass of inputs within a unit process. The sum of the total neglected flows does not exceed 5% of all energy consumption and mass of inputs.
- All flows known to contribute a significant impact or to uncertainty are included;
- The cut-off rules are not applied to hazardous and toxic material flows – all of which are included in the life cycle flow inventory.

**Background Data**

All upstream material, resource and energy carrier inputs have been sourced from various industry-average datasets and literature. Care was taken to fill known data gaps as recorded in the US LCI database profiles.

Tables 3 through 5 describe each LCI data source for raw materials (A1), transportation by mode (A2) and the core manufacture process (A3). Tables 2 through 4 also include a data quality assessment for all secondary data on the basis of the technological, temporal, and geographical representativeness as per Section 2.1.7 of the UL PCR.

**Table 3: A1 – Raw Material Supply**

Materials	LCI Data Source
<b>Calcium Silicate Brick Inputs</b>	
Sand	ecoinvent process: “Gravel, round, at mine”, ecoinvent 2.02
Lime	Lime, hydrated, loose weight {CA-QC}  production   Alloc Def, U Modified with Ontario electricity
Silicate	Ecoinvent Process: Silica sand {RoW}  production   Alloc Def, U Modified with Ontario electricity.
Pigment	Spine Database: CPM Chalmers Data for Iron Oxide – modeled with ecoinvent V3 technosphere inputs
<b>Mortar Inputs</b>	
Cement	Cement Association of Canada EPD of General Use Cement
Sand	ecoinvent process: “Gravel, round, at mine”, ecoinvent 2.02 Modified with Ontario electricity
<b>Masonry Connector Inputs</b>	
Galvanized Steel	World Steel Association Data for hot dipped galvanized steel

**Table 4: A2 - Transportation**

Process	LCI Data Source
Rail, ocean freighter and barge*	USLCI - rail transport, diesel powered; ocean freighter, average fuel mix; barge, average fuel mix
Road	USLCI 2014 – single unit truck transport, diesel powered, short haul US avg.;

**Table 5: A3 - Manufacturing**

Process	LCI Data Source
<b>Electricity</b>	Arriscraft purchased electricity grid mix- Electricity, medium voltage, at grid, ON (ecoinvent v3.01)
<b>Natural Gas</b>	USLCI - Natural gas, combusted in industrial boiler/US
<b>Diesel</b>	USLCI - Diesel, combusted in industrial equipment/US
<b>Liquefied Propane Gas</b>	USLCI - Liquefied petroleum gas, combusted in industrial boiler/US
<b>Non-Hazardous Solid Waste</b>	Internal waste handling included in A3 manufacturer data

**Data Quality**

Data quality requirements, as specified in the UL PCR: 2013, section 2.1.7, are applied. This LCA and resulting EPD was created using industry average data for upstream materials. Data variation can result from differences in supplier locations, manufacturing processes, efficiency and fuel types used. All LCI data (Tables 3 through 5) were assessed on the basis of the three data quality indicators listed below. Each indicator is interpreted with respect to its context and key determining data parameters.

**Technical representativeness:** *The degree to which the data reflects the actual technology(ies) used.* Core manufacturing process technology is derived from very recent annual data covering the specific plants at which the products are manufactured. Background data are deemed to be reflective of typical or average technologies used. Some background material and process data are European but deemed to be similar to technologies used in the US and Canada. *Overall quality: Good to very good*

**Temporal representativeness:** *The degree to which the data reflects the actual time (e.g. year) or age of the activity.* Core manufacturing process data is very recent (2015). All significant LCI data sources, those that exercise a large influence over the calculated results, are generally less than 10 years old. *Overall quality - Fair to very good*

**Geographical representativeness:** *The degree to which the data reflects the actual geographic location of the activity (e.g. country or site).* Geographical coverage of core manufacturing processes is specific to the Arriscraft facilities in Ontario. All energy profiles reflect Ontario-specific conditions for foreground processes, and North American averages for other inputs. Some material (aggregates and admixtures) and process data are based on European sources. *Overall quality - Fair to very good*

## Life Cycle Impact Assessment

Life cycle impact assessment (LCIA) is the phase in which the set of results of the inventory analysis – the inventory flow table – is further processed and interpreted in terms of environmental impacts and resource use inventory metrics. As specified in the UL PCR, Table 3, the IPCC AR5 and the US EPA Tool for the Reduction and Assessment of Chemical and Other Environmental Impacts (TRACI), version 2.1, 2013 impact categories were used. Table 6 below summarizes the LCA results for the cradle-to-gate (A1-A3) product system of calcium silicate cladding.

**Table 6: LCA Results**

**Description of the System Boundary**

(x : included in LCA; mnd: module not declared)

Product			Construction Installation		Use							End-of-life				Benefits of Loads Beyond the System Boundary		
Raw Material supply	Transport	Manufacturing	Transport	Construction/Installation	Use	Maintenance	Repair	Replacement	Refurbishment	Operational Energy Use	Operational Water Use	De-Construction/ Demolition	Transport	Waste processing	Disposal	Reuse	Recovery	Recycling
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D	D	D
x	x	x	mnd	mnd	mnd	mnd	mnd	mnd	mnd	mnd	mnd	mnd	mnd	mnd	mnd	mnd	mnd	mnd

**Impact Assessment Results: A1-A3 100 Square Feet of Calcium Silicate Cladding**

Environmental Indicator	Unit	A1-A3 Total
Global Warming Potential (climate change)	kg CO2 eq	2.8E+02
Ozone Depletion Potential	kg CFC-11 eq	1.7E-05
Acidification Potential	kg SO2 eq	1.7E+00
Eutrophication Potential	kg N eq	7.0E-02
Photochemical Ozone Creation/Smog Potential	kg O3 eq	1.9E+01
Total use of non-renewable primary energy	MJ	3.4E+03

**Comparability of EPDs:**

Full conformance with the PCR for North American Cladding Product Systems allows EPD comparability only when all stages of a Cladding Product System's life cycle have been considered. However, variations and deviations are possible.

Environmental declarations from different programs may not be comparable. Comparison of the environmental performance of **CLADDING PRODUCT SYSTEMS** 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.

**Interpretation**

Table 7 provides a contribution analysis of the impact assessment results by information module. Tables 8 and 9 show the breakdown of the impacts caused by the two most significant cradle-to-gate modules as identified in Table 7. Table 8 shows the A1 breakdown and Table 9 shows the A3 breakdown.

**Table 7: Interpretation (A1-A3) 100 Square Feet of Calcium Silicate Cladding**

Environmental Indicator	Unit	Total	A1	A2	A3
Global Warming Potential (climate change)	kg CO <sub>2</sub> eq	2.8E+02	1.5E+02	1.4E+01	1.2E+02
Ozone Depletion Potential	kg CFC-11 eq	1.7E-05	8.4E-06	5.9E-10	8.4E-06
Acidification Potential	kg SO <sub>2</sub> eq	1.7E+00	5.6E-01	1.8E-01	9.7E-01
Eutrophication Potential	kg N eq	7.0E-02	3.0E-02	1.0E-02	3.0E-02
Photochemical Ozone Creation/Smog Potential	kg O <sub>3</sub> eq	1.9E+01	8.7E+00	4.6E+00	6.0E+00
Total use of non-renewable primary energy	MJ	3.4E+03	1.0E+03	2.0E+02	2.2E+03

Table 7 shows that the majority of the environmental burdens are almost equally split between raw materials use (A1) and core manufacturing (A3) of the Calcium silicate brick.

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**Table 8: Interpretation (A1) 100 Square Feet of Calcium Silicate Cladding**

Environmental Indicator	Unit	Total	Lime	Other CaSi Inputs	Ties and Mortar
Global Warming Potential (climate change)	kg CO2 eq	1.5E+02	1.1E+02	1.0E+01	2.5E+01
Ozone Depletion Potential	kg CFC-11 eq	8.4E-06	7.7E-06	6.1E-07	1.3E-07
Acidification Potential	kg SO2 eq	5.6E-01	4.0E-01	7.0E-02	9.0E-02
Eutrophication Potential	kg N eq	3.0E-02	1.0E-02	1.0E-02	1.0E-02
Photochemical Ozone Creation/Smog Potential	kg O3 eq	8.7E+00	6.1E+00	1.3E+00	1.3E+00
Total use of non-renewable primary energy	MJ	1.0E+03	6.4E+02	1.5E+02	2.4E+02

Table 8 shows that the lime drives the impacts in every category. The lime use also causes disproportionate greenhouse gas emissions (CO<sub>2</sub>) due to the calcination process, causing roughly 40% of all global warming potential.

**Table 9: Interpretation (A3) 100 Square Feet of Calcium Silicate Cladding**

Environmental Indicator	Unit	Total	Natural Gas	Electricity	Other
Global Warming Potential (climate change)	kg CO2 eq	1.2E+02	8.3E+01	2.0E+01	1.6E+01
Ozone Depletion Potential	kg CFC-11 eq	8.4E-06	6.4E-06	7.6E-07	1.3E-06
Acidification Potential	kg SO2 eq	9.7E-01	6.9E-01	1.6E-01	1.2E-01
Eutrophication Potential	kg N eq	3.0E-02	1.0E-02	1.0E-02	1.0E-02
Photochemical Ozone Creation/Smog Potential	kg O3 eq	6.0E+00	1.9E+00	1.1E+00	3.0E+00
Total use of non-renewable primary energy	MJ	2.2E+03	1.3E+03	6.1E+02	3.0E+02

Table 9 indicates that the energy use at the Cambridge facility drives the A3 impacts. Natural gas consumption accounts for 70% of the global warming potential caused in A3.

## References

1. Athena Institute: 1998 - Life Cycle Analysis of Brick and Mortar Products (1998). Published by the Athena Institute.
2. Athena Institute: 2016 - A Cradle-to-Gate Life Cycle Assessment of Calcium Silicate and Natural Stone Cladding Manufactured by Arriscraft. Background LCA report to this EPD.
3. EN 15804:2012 Sustainability of construction works – Environmental product declarations – Core rules for the product category of construction products.
4. ISO 21930: 2007 Building construction – Sustainability in building construction – Environmental declaration of building products.
5. ISO 14025: 2006 Environmental labeling and declarations - Type III environmental declarations - Principles and procedures.
6. ISO 14044: 2006 Environmental management - Life cycle assessment - Requirements and guidelines.
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8. National Renewable Energy Laboratory 2014. U.S. Life Cycle Inventory Database.  
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9. Underwriters Laboratory: Product Category Rule (PCR) for Preparing an Environmental Product Declaration (EPD) for Product Group Cladding System Products; Version June 18, 2015.