



ENVIRONMENTAL PRODUCT DECLARATION

1 ROCKWOOL® REDAir™ FLEX ventilated façade system

According to EN 15804:2012

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LCA study

This environmental product declaration is based on an LCA background study according to EN15804:2012 carried out by:

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Verification :

External independent verification of the LCA background report and EPD declaration, according to EN ISO 14025:2010

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**EPDs may not be comparable if they do not comply with
EN15804:2012**

Product

ROCKWOOL® REDAir™ FLEX system, a cladding system for ventilated façade applications. It is comprised of an insulation layer, anchoring screws and a sub-construction. The reference calculation is done for the average thickness – 175 mm – of the current market. The system can be finished using a variety of cladding panels. The cladding panels are not within the scope of this EPD.

2 General information about EPD and product

Functional unit

1 square meter (m²) of external wall thermal insulation in Europe for a period of 50 years.

The application is for a ventilated façade, including stone wool insulation, wood sub-construction, and anchors screws.

The results in this EPD are related to an insulation thickness of 175 mm. The R-value of the system, including the insulation and screws, is 4.40 m².K/W.

Intended application of the EPD

The EPD is for information supply to interested parties in Europe and customers of ROCKWOOL® interested in the environmental performance of the REDAir™ FLEX system, such as architects, builders and also LCA experts and LCA database owners and other audiences that have an interest in EPDs.

The EPD is for business-to-business communication.

Product description

The REDAir™ system consists of ROCKWOOL® stone wool batts that are currently produced in Vamdrup, Denmark. The system is currently available in Denmark, Sweden, Norway and the Netherlands. The system will be available soon in the United Kingdom and Germany.

The stone wool batts are added to the outside of a building and are mounted using laminated veneer lumber (LVL) boards that are connected to the stone wool using metal friction plates and attached to the existing wall using metal screws.

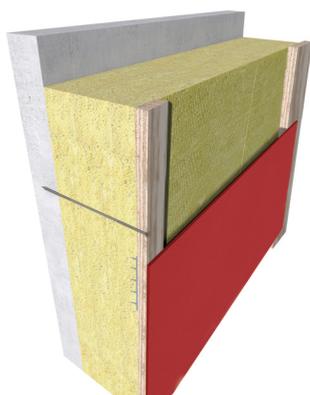


Figure 1. REDAir™ FLEX system overview

The wall and cladding panels are not part of the REDAir™ product offering and included only for illustration purposes.

Table 1. Components of the REDAir™ FLEX system per m²

Part	Weight (kg/m ²)
ROCKWOOL® stone wool	13.1 (average for reference calculation)
LVL	2.62
Friction plate	0.115
Screws	0.0888

The system can be finished using a variety of cladding panels, such as ROCKPANEL®, but the cladding is not included in this EPD.

The system is available on the market with stone wool thicknesses of 100 – 150 – 200 – 250 mm or double-layer combinations of these up to 350 mm. Approximately 80% of the sold volume is either 150 or 200 mm. Therefore, the thickness is 175 mm on average and this theoretical thickness is chosen as the reference for the calculations in this EPD. This 175 mm corresponds to an R-value of 4.40 m².K/W of the system including the screws, but excluding the wall and cladding panel as they are not part of the thermal insulation associated with the REDAir™ FLEX system.

The LCA results for specific thicknesses can be obtained by scaling the LCA results of the stone wool part and combining these with the LCA results of the other parts of the system. A spreadsheet with separate LCA results for each of the components is available for this purpose at ROCKWOOL®.

Product specification

ROCKWOOL® stone wool is made from volcanic rock, typically basalt or dolomite, and an increasing proportion of recycled material. For the REDAir™ stone wool the secondary materials are almost 20% of the mineral fraction. The mineral fibres are bound by a binder with an average binder content of 3.2% for the stone wool in the REDAir™ FLEX system. The binder is a water-based phenol-formaldehyde resin which is polymerized into bakelite during production of the final stone wool product.

LVL is made using Scottish pine wood and is Forest Stewardship Council (FSC) certified. Phenol formaldehyde is used as glue in the production of the LVL board in amounts of

about 1.7 % (w/w). In order to ensure durability, the final strips are treated with components commonly used for wood preservation in housing and other buildings. For extra durability, the anodized screws and friction plate have an extra coating (C4 Grade).

Reference service life

The reference service life of REDAir™ is defined as 50 years. This is a scenario based on an assumption for a default building. Different buildings have different service lives; some may last longer while others may have a shorter life time. REDAir™ is used in both residential and commercial applications. The components from the REDAir™ FLEX system do not have to be replaced in the 50-year scenario, except for the LVL and the friction plate for which one

replacement is assumed in a 50-year period as a worst-case scenario.¹

The modular presentation of the LCA results in this EPD allows the user to model other scenarios. If there is no replacement during the lifetime of the building, the results for Module B4 can simply be deleted. This can be relevant for buildings that last less than 50 years. When a user wants to model multiple rounds of maintenance, the results for module B4 can be multiplied as necessary. This could be relevant for a building that lasts longer than 50 years.

¹This scenario is based on simulated ageing tests for ROCKWOOL® stone wool, European Technical Approval (ETA) documents for the components and assumptions for the LVL, as well as current practice where most often insulation material is not replaced during the lifetime of the building.

Table 2. Reference service life considerations

Parameter	Unit
Reference service life	50 years for the system, with one replacement of the LVL and friction plate
Declared product properties	Stone wool: EN13162-T3-DS(TH)-WS-MU1 – Lambda 33, reaction to fire Euroclass A1 (non-combustible) LVL fire treated & mould treated Screws and friction plate with corrosion class C4 System ETA-13/0900 according to ETAG 034 (pending)
Design application parameters	See installation guidelines for building height limits, ventilation cavity requirements, and suitable supporting wall structures. Quantity of screws to be calculated on project basis: see online calculator for guidance on www.redair.com Installation to be conducted in accordance with the manufacturer's installation guide. Guidance on safe and effective installation is also provided through local organizations and at the end of this EPD. Cladding to be applied in accordance with cladding manufacturer's guide.
Quality of work assumption	It is assumed that the manufacturer's instructions are clear and followed. In case of any uncertainty, the manufacturer should be contacted for instructions.
Outdoor environment	Application will resist visual & structural weathering effects to the extent described in ETA documentation and warranty coverage. Specific project considerations should be made to account for load conditions, weight, nominal wind speeds, and terrain factors. REDAir™ FLEX system may contribute to but does not assure air or water tightness to the building. Seismic conditions are not considered.
Indoor environment	REDAir™ FLEX system is used externally on buildings outside the vapour barrier and is not in contact with the indoor climate.
Usage conditions & maintenance	Installation is a one-time procedure. After mounting, the system shall be maintained by simple visual inspection – any movement of façade elements should be inspected and mitigated. The product addressed by the EPD will not come into contact with water or soil, because it will be encapsulated by the cladding which is not a part of the EPD.

4 LCA: Scenarios and calculation rules

EPD type

Cradle-to-grave. Included are:

- Production stage (modules A1–A3)
- Installation stage (modules A4 – transport to site, and A5 – installation into the building)
- Use stage (module B4 – replacement; the other modules are not relevant)
- End-of-life stages (modules C1 – deconstruction, C2 – transport, C3 – waste processing and C4 – disposal)
- Module D (recovery and recycling)

Flow diagram system boundaries

The system boundaries are shown in Figure 2.

Note: The production process of the ROCKWOOL® stone wool is not outlined in Figure 2, but described in more detail below. The data for the stone wool are based on a recent EPD from the EPD-Norge programme² and therefore not modelled again for this EPD.

The recycling of stone wool is not explicitly shown in the diagram but takes place in certain situations. The scenarios are described in the text below the diagram.

² <http://www.epd-norge.no/getfile.php/PDF/EPD/Byggevarer/NEPD%2000131E%20rev1%20Rockwool%281%29.pdf>

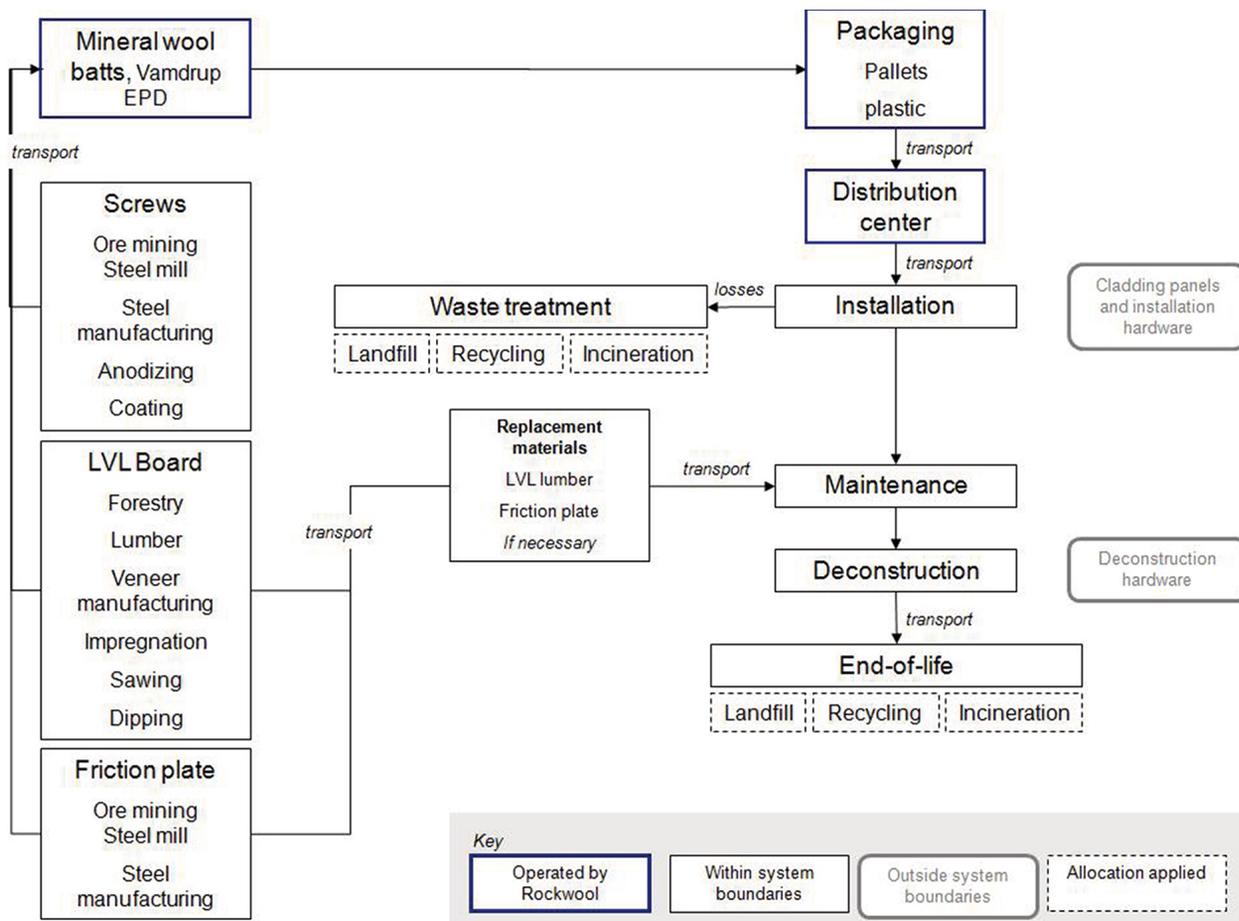


Figure 2. Flow diagram of system boundaries

Description and modelling of the processes and scenarios

Modules A1–A3 Production stage

The production of stone wool for the REDAir™ system takes place in one ROCKWOOL plant in Vamdrup, Denmark. Specific EPD data for this plant are used, as collected and calculated for the EPD-Norge [FORCE Technology, 2013], with primary data collected for the financial year 2011 (one-year average).

LVL is made using FSC certified pine wood.

All production and transportation steps are within the system boundaries as defined in the draft EN16485 PCR for wood [FprEN 16485:2013], including impregnation and treatment. In order to maintain durability, the LVL board is impregnated with flame retarder and treated with biocide. All materials used are approved in the EU for use in the protection of external used wood products. Packaging with plastic cord is also included.

For both the screws and the friction plates all production processes, transport and packaging are included.

Orders are put together in Vamdrup ready for transportation to regional distribution centres.

The screws and friction plate are packed in small cardboard boxes. Single-use pallets are used for the mineral wool. Pallets are topped with a plastic sheet and wrapped in foil. The LVL is bundled with plastics straps and loaded on to the truck next to the pallets. Wooden blocks are used to support them. The amount of wood and plastic is small compared to the packaging of the mineral wool and is therefore excluded from the calculations.

Module A4 Installation stage – transport to site

The REDAir™ system is either delivered directly to the project site (Scandinavia), or indirectly through central distribution locations. The complete delivery (stone wool + screws + LVL etc.) is packed onto the same truck for delivery to site. Truck sizes vary according to shipment size. Outside Scandinavia (BNL, Germany, UK) central distribution centres will be used.

The weighted average distance, based on expected market sizes, is 850 km (including transport to and from warehouse).

Table 3 outlines the specific distances.

Table 3. Country-specific distances

Country	Distance to warehouse (km)	Distance from warehouse to customer (km)
Denmark	0	250
Sweden	0	900
Norway	600	200
United Kingdom	1400	400
Benelux	730	150
Germany	980	250 (most projects in south east)

To be able to select the applicable distance for various situations, the EPD data are provided "per 250 km" to reflect the Danish situation which represents the bulk of the current market. Data from module A4 can be scaled linearly for the other countries (see Table 4).

Table 4. EN15804 transportation considerations

Parameter	Unit
Fuel type and consumption of vehicle or vehicle type	Diesel, 1 litre per 3 km, by trailer, 88m ³ volume
Distance	Varies per country, average is 850 km. Default for EPD (scalable) is 250 km. (25% empty return [conservative])
Capacity utilisation (including empty returns)	85%
Bulk density of transported products	Volume-based transport products
Volume capacity utilisation factor (factor: =1 or <1 or ≥ 1 for compressed or nested packaged products)	1

Module A5 Installation stage – installation

The installation requires the use of hand-held tools, some of which are power tools and consume electricity. The power tool energy cost is calculated for an average square meter of the mounted systems on the wall. This is modelled using national grid mix data weighted for the market shares (see Table 5).

Table 5. EN15804 installation considerations

Parameter	Unit
Ancillary materials for installation (specified by material)	No other materials are needed in addition to the ones included in the REDAir™ FLEX system
Water use	None
Other resource use	Power tools, cutting knives and drills. They are considered as capital goods. Use is included
Quantitative description of energy type (regional mix) and consumption during the installation process	0.0284 kWh/m ²
Wastage of materials on the building site before waste processing, generated by the product's installation (specified by type)	2% of mineral wool, LVL, friction plates and screws
Output materials (specified by type) as result of waste processing at the building site	See Table 6 with building waste scenarios
Direct emissions to ambient air, soil and water	None

Cut sections of stone wool can be used elsewhere. The LVL boards are cut and the remainder can be used to start the next series. Extra screws would typically be used up for extra strengthening, saved for the next project, or recycled. The same applies to the friction plates. Estimated waste for all components is 2%.

ROCKWOOL® stone wool can either be recycled or landfilled. In some countries ROCKWOOL® has a return service in place. In that case the stone wool is returned to ROCKWOOL® for recycling. The wood will be sorted out and incinerated with energy recovery. The incineration is assumed to have an efficiency of less than 60%, which means that the incineration is regarded as a waste treatment. Screws and friction plates will be recycled as iron.

Since REDAir™ is typically easy to dismantle, a scenario of sorting and recycling is very likely to occur if the infrastructure is present. Table 6 considers the following scenarios for the treatment of the building waste.

Table 6. Building waste scenarios

Material	Landfill (% [km])	Recycling (% distance [km])	Energy recovery (% distance [km])
Scenario: high recycling (Denmark, the Netherlands)			
Mineral wool	5%, 50 km	95%, 100 km	
Wood	5%, 50 km		95%, 100 km
Metal	5%, 50 km	95%, 150 km	
Scenario: low recycling (other EU markets)			
Mineral wool	100%, 50 km		
Wood	20%, 50 km		80%, 100 km
Metal	20%, 50 km	80%, 150 km	

Module B4 Use stage

In the 50 years' lifespan of a building, one replacement of LVL and friction plate is assumed. This EPD includes the material use and electricity consumption for the use of power tools (as defined for the installation above), and doubles the electricity use in order to model both the deconstruction and the repeated installation (see Table 7).

Table 7. EN15804 use phase, module B4 considerations

Parameter	Unit
Replacement cycle	LVL and friction plate every 25 years
Energy input during maintenance	0.0284 kWh/m ² for deconstruction 0.0284 kWh/m ² for repeated installation
Exchange of worn parts during product's life cycle	None

Modules C1–C4 End-of-life

The deconstruction is modelled similar to the installation scenario. The transportation distances and waste processing and landfill scenarios are identical to the building waste scenario as defined above. The EPD values reflect the high recycling scenario. The results do not differ significantly for the lower recycling scenario since landfill of stone wool has minor environmental impacts. If landfilled, ROCKWOOL® stone wool can be disposed of as non-hazardous waste. For end-of-life considerations, see Table 8.

Module D Benefits and loads beyond the system boundary

In Module D the loads and benefits are reported on the products that result from waste treatment over the life cycle, steel recycling and thermal energy recovery from combustion of wood and plastic packaging. The allocation of combustion impacts is based on a physical classification of the mass flows or calorific values.

Cut-off criteria

Data sets are complete according to cut-off rules of EN15804 (inclusion of all material and energy inputs >1%, inclusion of all materials with potential environmental impact and <5% of the total energy use and mass neglected). The most notable cut-off based on these criteria is the use of product labels.

Table 8. EN15804 end-of-life considerations

Parameter	Unit	Recycling high	Recycling low
Collection process specified by type	kg collected separately	16.0	2.26
	kg collected with mixed construction waste	0.00	13.7
Recovery system specified by type	kg for re-use	0.00	0.00
	kg for recycling	12.7	0.163
Disposal specified by type	kg for energy recovery	0.00	0.00
	kg for thermal waste treatment	2.49	2.10
	kg product or material for final deposition	0.798	13.7
Assumptions for scenario development		As for building waste	

8 LCA: Results

The life cycle stages included are shown in Figure 3.

Limitations

Results provided relate to the average thickness of the current market – 175 mm. Please contact ROCKWOOL® if you need figures for specific thicknesses. A spreadsheet for this purpose is available at ROCKWOOL® from the LCA Background Report.

Transport distances are provided "per 250 km". Data from module A4 can be scaled linearly for the other countries: for example, delivery in Germany is ~1250 km and would require five times the amount declared (1250/250=5).

Product stage			Construction installation stage		Use stage							End of life stage				
Raw materials	Transport	Manufacturing	Transport	Construction installation stage	Use	Maintenance	Repair	Replacement	Returbishment	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	NR	NR	NR	X	NR	NR	NR	X	X	X	X	X

NR not relevant

Figure 3. Life cycle stages included and excluded in the calculation.

Table 9. Parameters describing the environmental impacts

Parameter	A1-3	A4	A5	B4	C1	C2	C3	C4	D
GWP	1.53E+01	7.89E-01	1.19E+00	2.12E+00	1.25E-02	5.39E-03	2.30E-01	5.51E-03	-1.13E+00
ODP	2.81E-07	5.13E-08	-2.54E-08	8.66E-08	1.14E-09	3.52E-10	3.68E-09	-2.60E-10	-1.07E-07
AP	1.34E-01	2.58E-03	2.29E-03	1.20E-02	2.91E-05	1.81E-05	1.87E-04	-5.21E-06	-2.40E-03
EP	1.38E-02	5.35E-04	2.35E-04	1.45E-03	4.51E-06	3.78E-06	2.51E-05	1.23E-06	-2.21E-04
POCP	1.02E-02	5.65E-05	1.84E-04	8.78E-04	1.41E-06	3.88E-07	9.96E-06	1.55E-06	-2.98E-04
ADPM	4.71E-05	3.52E-09	9.16E-07	1.10E-06	3.73E-09	2.42E-11	4.31E-07	-5.88E-10	-1.41E-07
ADPE	2.14E+02	1.13E+01	1.63E-01	1.94E+01	1.51E-01	7.73E-02	4.68E-01	-3.51E-02	-1.51E+01

GWP Global warming potential (kg CO₂-eqv.); ODP Depletion potential of the stratospheric ozone layer (kg CFC₁₁-eqv.); AP Acidification potential of land and water (kg SO₂-eqv.); EP Eutrophication potential (kg PO₄₋₃-eqv.); POCP Formation potential of tropospheric photochemical oxidants (kg C₂H₄-eqv.); ADPM Abiotic depletion potential for non-fossil resources (kg Sb-eqv.); ADPE Abiotic depletion potential for fossil resources (MJ)

Table 10. Parameters describing resource use

Parameter	A1-3	A4	A5	B4	C1	C2	C3	C4	D
RPEE	1.72E+01	0.00E+00	-1.06E+01	-2.43E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	-3.48E+01
RPEM	4.85E+01	0.00E+00	9.70E-01	2.66E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
TRPE	6.57E+01	0.00E+00	-9.67E+00	2.29E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	-3.48E+01
NRPE	2.21E+02	1.13E+01	-3.92E-01	2.03E+01	2.19E-01	7.78E-02	6.80E-01	-4.60E-02	-1.75E+01
NRPM	5.39E+00	0.00E+00	1.08E-01	1.19E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	-6.05E-02
TPE	2.26E+02	1.13E+01	-2.84E-01	2.15E+01	2.19E-01	7.78E-02	6.80E-01	-4.60E-02	-1.76E+01
SM	3.44E+00	0.00E+00	6.87E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RSF	4.76E-01	0.00E+00	9.52E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NRSF	2.47E+00	0.00E+00	4.94E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
W	1.96E+00	1.15E-02	-1.79E-01	2.20E-01	2.24E-02	7.91E-05	3.47E-02	-3.58E-03	-7.85E-01

RPEE Renewable primary energy resources used as energy carrier (MJ); RPEM Renewable primary energy resources used as raw materials (MJ); TRPE Total use of renewable primary energy resources (MJ); NRPE Non-renewable primary energy resources used as energy carrier (MJ); NRPM Non-renewable primary energy resources used as materials (MJ); TPE Total use of non-renewable primary energy resources (MJ); SM Use of secondary materials (kg); RSF Use of renewable secondary fuels (MJ); NRSF Use of non-renewable secondary fuels (MJ); W Use of net fresh water (m³)

Table 11. Other environmental information describing waste categories

Parameter	A1-3	A4	A5	B4	C1	C2	C3	C4	D
HW	1.09E-01	6.58E-06	2.16E-03	7.86E-04	1.14E-06	4.51E-08	4.06E-06	-1.79E-07	-4.49E-05
NHW	3.27E+00	1.53E-04	6.50E-02	1.82E-02	2.64E-05	1.05E-06	9.41E-05	-4.16E-06	-1.04E-03
RW	0.00E+00	0.00E+00							

HW Hazardous waste disposed (kg); NHW Non-hazardous waste disposed (kg), RW Radioactive waste disposed (kg)

Table 12. Other environmental information describing output flows

Parameter	A1-3	A4	A5	B4	C1	C2	C3	C4	D
CR	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MR	0.322	0.00	0.256	0.00	0.00	0.00	12.7	0.00	12.6
MER	0.0101	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
EE	0.00	0.00	11.6	8.67	0.00	0.00	8.67	0.00	0.00

CR Components for reuse (kg); MR Materials for recycling (kg); MER Materials for energy recovery (kg); EE Exported energy (MJ)

11 Other information

Dangerous substances (ROCKWOOL® statement)

REDAir™ FLEX system insulation materials do not contain substances of very high concern (SVHC) according to the EU-REACH candidate list <http://echa.europa.eu/candidate-list-table> (version July 12-2013). For more information on the insulation a ROCKWOOL® Safe Use Instruction Sheet (SUIS) is available upon request.

The REDAir™ FLEX system LVL boards are impregnated with flame retardant and are treated with biocide in order to maintain their durability during use. All materials used are approved in the EU for the intended use for the protection of external used wood products. The LVL board does not require labelling or classification according to REACH. For more information a Safety Data Sheet is available upon request.

For the friction plate and screws no specific hazards are known to ROCKWOOL®. A Safety Data Sheet for the friction plate is available upon request.

Instructions for safe installation

LVL board:

When cutting LVL boards use gloves, goggles and protection against wood dust by using a filter mask suited for protection against wood dust. A Safety Data Sheet is available upon request.

Stone wool:

Due to the well-known mechanical effect of coarse fibres, mineral wool products may cause temporary skin itching. Mineral wool fibres cannot cause a chemical or allergic reaction.

To diminish the mechanical effect of coarse fibres and prevent unnecessary exposure to mineral wool dust, information on good practices is available on the packaging of all mineral wool products with pictograms and/or written tips (see below). Safe Use Instruction Sheets similar to Safety Data Sheets are also available from each producer.

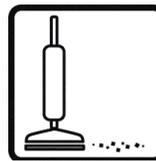
**Cover exposed skin.
When working in
unventilated area wear
disposable face mask**



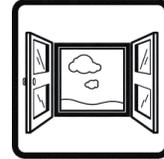
**Rinse in cold water
before washing**



**Clean area using
vacuum equipment**



**Ventilate working area
if possible**



**Waste should be
disposed of according
to local regulations**



**Wear goggles when
working overhead**



12 Bibliography

EN 15804:2012+A1 October 2013: Sustainability of construction works — Environmental product declaration — Core rules for the product category of construction products

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EN 13162:2008: Thermal insulation products for buildings — Factory made mineral wool (MW) products — Specification

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FORCE Technology, 2013: LCA of stone wool insulation on the Scandinavian market from ROCKWOOL®, Project report September 2013

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